Spacelabs Medical
An OSI Systems Company

Ultraview® 1030 and Ultraview 1050 Monitors

90367, 90369

Service Manual

070-0706-01 Rev. K

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Spacelabs Medical is committed to providing comprehensive customer support beginning with your initial inquiry through purchase, training, and service for the life of your Spacelabs Medical equipment.

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Caution:

Rx Only **US Federal law restricts the devices documented herein to sale by, or on the order of, a physician.**

Before use, carefully read the instructions, including all warnings and cautions.

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Introduction

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Overview

Caution:

Spacelabs Medical's products are designed and manufactured under good manufacturing practices and in compliance with all applicable regulatory requirements. To ensure proper operation in accordance with these guidelines, this product must be maintained by trained technicians using Spacelabs Medical authorized replacement parts.

The 90367 Ultraview® 1030 monitor and the 90369 Ultraview 1050 monitor are fully PCIS™/ Ultraview Care Network-compatible and are designed for use as small bedside monitors or as battery-operated transport monitors. These monitors feature a 10.4-inch color display and an infrared touchscreen, and they can be operated on either mains power or battery.

A single-high module slot on the right side of the monitor accepts all single-high modules, including the 90470 Multiparameter module, 90496 Ultraview Command module, and 91496 Ultraview SL™ Command module, to permit monitoring of parameters such as ECG, temperature, and invasive pressure.

The optional 90310 Wireless Network Interface (WNI) provides a seamless network of communications with other Ultraview PCIS/PCMS™ monitors via a Wireless Local Area Network (WLAN). These flexible networks use the 90310 as the point of airwave transmit and receive for the Ethernet network interface. Networks can use a single channel or multiple channels with additional 90310 WNIs (the number required depends upon the number of waveforms per monitor and the number of monitors in use).

The capnography option provides integrated monitoring of $EtCO_2$, inspired CO_2, and respiratory rate. This option allows an external oxygen sensor to be attached to the Ultraview 1030/1050 transport monitor, which measures the FiO_2 parameter and adjusts the CO_2 reading to compensate for the presence of O_2.

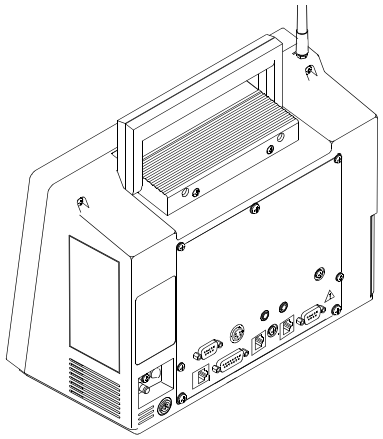

Figure 1-1: Ultraview 1030/1050 monitors (with Wireless Ethernet Option)

Monitor Hardware Options

The following hardware options are available for the Ultraview 1050 monitor:

Table 1: 90369 Ultraview 1050 Options

Option	Definition
-B	Basic I/O
-F	Ethernet Network Communications, Non-interactive
-G, -H, or -M	Capnography with Ethernet Network Communications
-N	Local Vital Signs Calculations
-O	Local Drug Dose Calculations
-P	Interactive and Advanced Network Functions
-Q	Data Shuttle
-R	Patient Data Logger (PDL)
-U	Dual-Channel Recorder
-Z	Wireless Ethernet
-04	Four Waveform Zones
-05	Five Waveform Zones
-06	Six Waveform Zones
-J	Dual-Channel Recorder for Polish Language

Example:

A 90369-XFQU04 (where “X” represents the language designator) is an Ultraview 1050 equipped with:

- F = Non-interactive Ethernet network communication
- Q = Data Shuttle option
- U = Recorder option
- 04 = Four waveform zones

The following hardware options are available for the Ultraview 1030 Monitor:

Table 2: 90367 Ultraview 1030 0ptions

Option	Definition
-B	Basic I/O
-F	Ethernet Network Communications, Non-interactive
-G or -H	Capnography
-P	Interactive and Advanced Network Functions
-Q	Data Shuttle
-R	Patient Data Logger (PDL)
-U	Dual-Channel Recorder
-Z	Wireless Ethernet
-03	Three Waveform Zones
-04	Four Waveform Zones

Example:

A 90367-XFQR03 (where “X” represents the language designator) is an Ultraview 1030 equipped with:

- F = Non-interactive Ethernet network communication
- Q = Data Shuttle option
- R = Patient Data Logger (PDL) option
- 03 = Three waveform zones

Setup

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Unpacking

The monitor, battery(s), external AC power supply, and any optional accessories are all packaged and shipped in a single box. Foam inserts protect all components during shipping.

Caution:

Printed circuit boards in this equipment contain static-sensitive devices. Handle them only at a static-safe workstation.

Keep the shipping box and the foam inserts for reshipping if the monitor should ever require factory service.

To pack the Ultraview 1030/1050:

1. Place foam end caps (❶ and ❷) around monitor (❸).
2. Place foam and Ultraview 1030/1050 into carton (❹).
3. Place top tray (❺) in carton on top of end caps.
4. Place foam accessory surround (❻) on top of tray.
5. Insert power supply (❼), battery (❽), and line cord (❾) into accessory surround.
6. Set top accessory surround (❻) in place.
7. Close shipping carton and tape.
8. Ship to:

   Spacelabs Medical, Inc.
   Attn: Equipment Service Center
   22011 SE 51st Street
   Issaquah, WA 98029
   1-800-522-7025

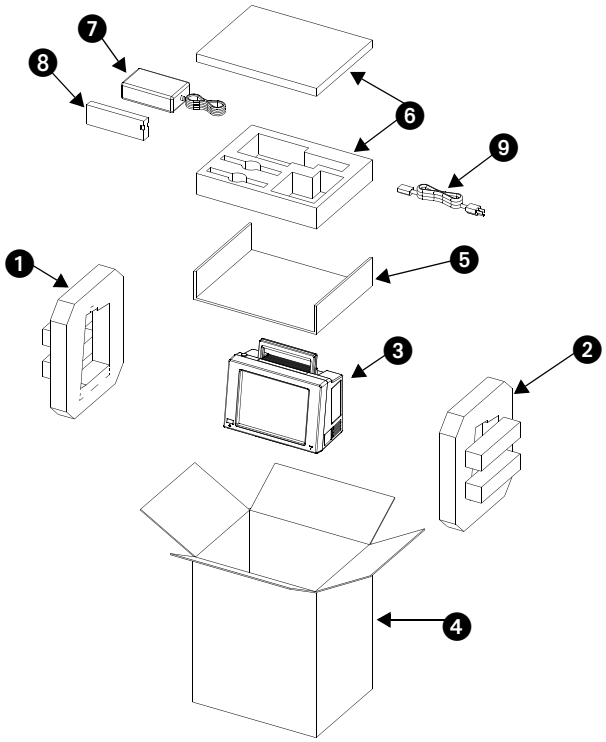


Figure 2-1: Unpacking the Ultraview 1030/1050 monitor

Batteries

Each monitor is supplied with one VCR-type battery (a second battery is optional). The monitor is capable of using two different types of batteries: sealed lead acid (SLA) (12 V, 2.3 Ah or equivalent) or Spacelabs Medical's nickel metal hydride (NiMH) (12 V, 2.45 Ah or equivalent).

Compatibility

Monitors with serial numbers starting with 367-1XXXX or 369-1XXXX incorporate a battery mating "contact frame" which will allow the use of either SLA or NiMH batteries with the monitor. Earlier monitors must be upgraded and will not accept the NiMH battery due to a "lockout feature" on the end of the battery. No modifications are required for the charging system for compatibility with either battery; the "smart" charger is capable of charging either type of battery.

Sealed Lead Acid (SLA)

SLA batteries are shipped fully charged and will require maintenance charging in the event they are to be stored on a shelf or with power disconnected from the monitor for more than three (3) months. SLA batteries must be "top charged" or, at a minimum, placed into the monitor and plugged into AC power for a minimum of two (2) hours every three (3) months to maintain their rated capacity.

Nickel Metal Hydride (NiMH)

NiMH batteries are shipped in a discharged state and will require some conditioning and charging prior to use. When the batteries are received new, place them into a monitor *not attached to AC power* and turn the monitor ON so that it runs on battery power alone. After the monitor has shut itself OFF and the battery is discharged, attach the external power supply to the unit. Verify that the green LED is flashing and let the batteries (or battery) charge for a minimum of two (2) hours. Be sure that the monitor is turned OFF to expedite the charging process. After the LED on the front of the monitor has stopped flashing, disconnect the AC brick from the unit again and turn the unit ON, allowing it to discharge the batteries again and turn itself OFF. Repeat this process for three (3) charge/discharge cycles. Completing the above procedure will ensure that the batteries perform up to their maximum capacity during their first use in the field.

A NiMH battery will exhibit a substantial increase in “cycle life” or the number of charge/discharge cycles, compared to an SLA battery, before the end of its life.

Battery Use

Batteries may be changed during battery or AC operation without losing data, provided that one charged battery remains connected at all times during the exchange.

During AC operation and with batteries installed, the green LED (front, lower right of monitor as shown in Figure 2-3) flashes to indicate changes in the status of the batteries:

- Constant green — the battery is fully charged
- Slow flash — the battery is being charged
- Three quick flashes followed by one slow flash — the battery is bad

During battery operation, the green LED will not be lit.

Battery Storage and Maintenance

Sealed Lead Acid (SLA)

If the monitor is not expected to be used for a long time, it is recommended that the batteries be removed from the unit and stored separately. The batteries should be stored under the following conditions:

- Low humidity
- 5° to 104° F (-15° to +40° C)
- Away from direct sunlight

After long-term storage, the battery delivers less than full capacity on the first cycle. When a battery is placed in extended storage, it is recommended that it receive a refresh charge at the following intervals:

Storage Ambient Temperature	Recommended Interval
Below 68° F (20° C)	12 months
68° to 86° F (20° to 30° C)	6 months
86° to 104° F (30° to 40° C)	3 months

Caution:

- **Do not incinerate the battery.**
- **Do not directly connect the negative and positive terminals.**
- **Do not use other chargers than those specified by Spacelabs Medical.**
- **Do not drop the battery or subject it to strong physical shock.**
- **Do not use the battery to power equipment other than that specified by Spacelabs Medical.**
- **Do not use below environmental temperatures -10° C (15° F) or above 65° C (149° F). If the temperature exceeds this upper limit, a safety device will automatically prevent operation of the battery.**
  - **Flash PROM is to be installed only by Spacelabs Medical personnel.**
  - **To achieve a full recharge battery life (nominally 200 cycles):**
    - **store in a cool dark place.**
    - **fully charge battery immediately after use.**
    - **avoid direct sunlight.**

Nickel Metal Hydride (NiMH)

Nickel metal hydride (NiMH) batteries require no special attention during storage.

Storage should not exceed 12 months or degradation of capacity may result.

Typical life of NiMH batteries will be up to 600 charge/discharge cycles.

Storage Conditions:

<1 year at -20° to 35° C (-4° to 95° F)

Recycling of NiMH batteries is not required, however there are recycling stations which will reclaim the nickel in the expended batteries, so recycling whenever possible is recommended.

Assembly

Open the battery compartment door and insert the battery(ies) into the battery compartment, making sure to observe correct polarity (refer to *Figure 2-2*). Close the battery compartment door.

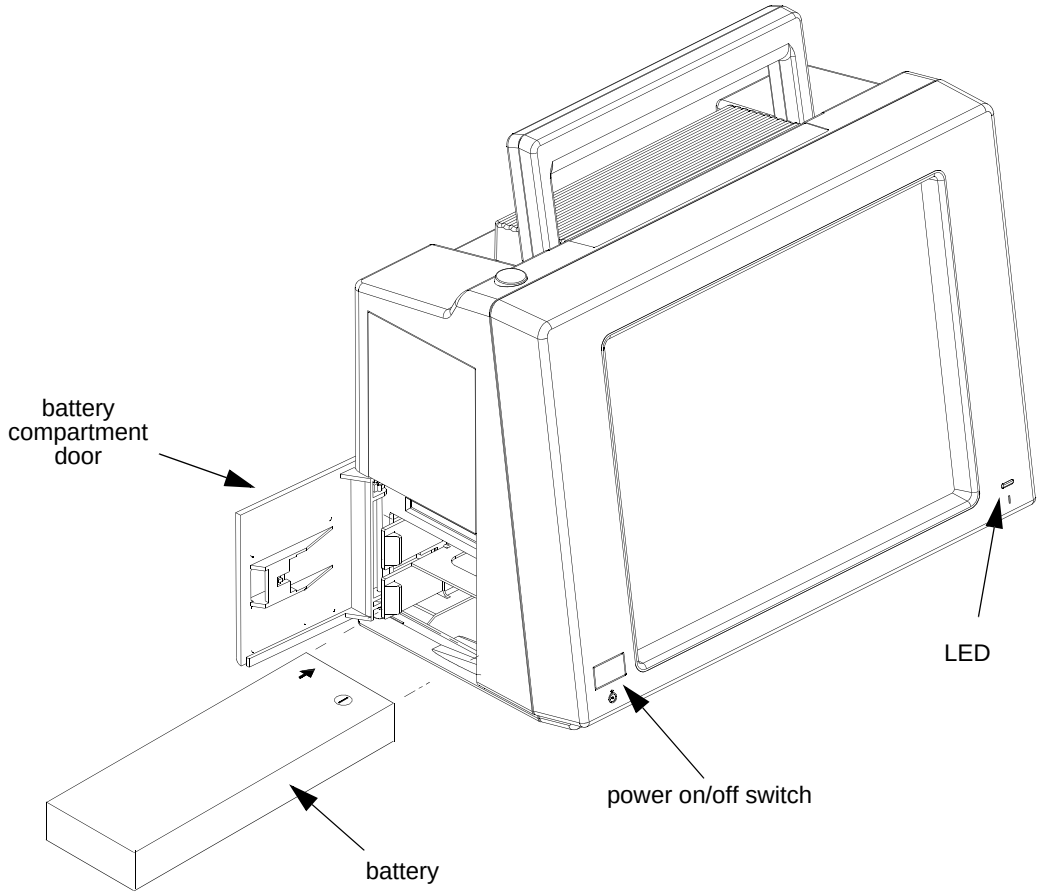


Figure 2-2: Battery installation

Caution:

The battery is not slot-dependent to function for monitor operation.

Back Panel Connections

Connections for the external power supply and the optional SDLC network and Remote Alarm are shown in *Figure 2-3*.

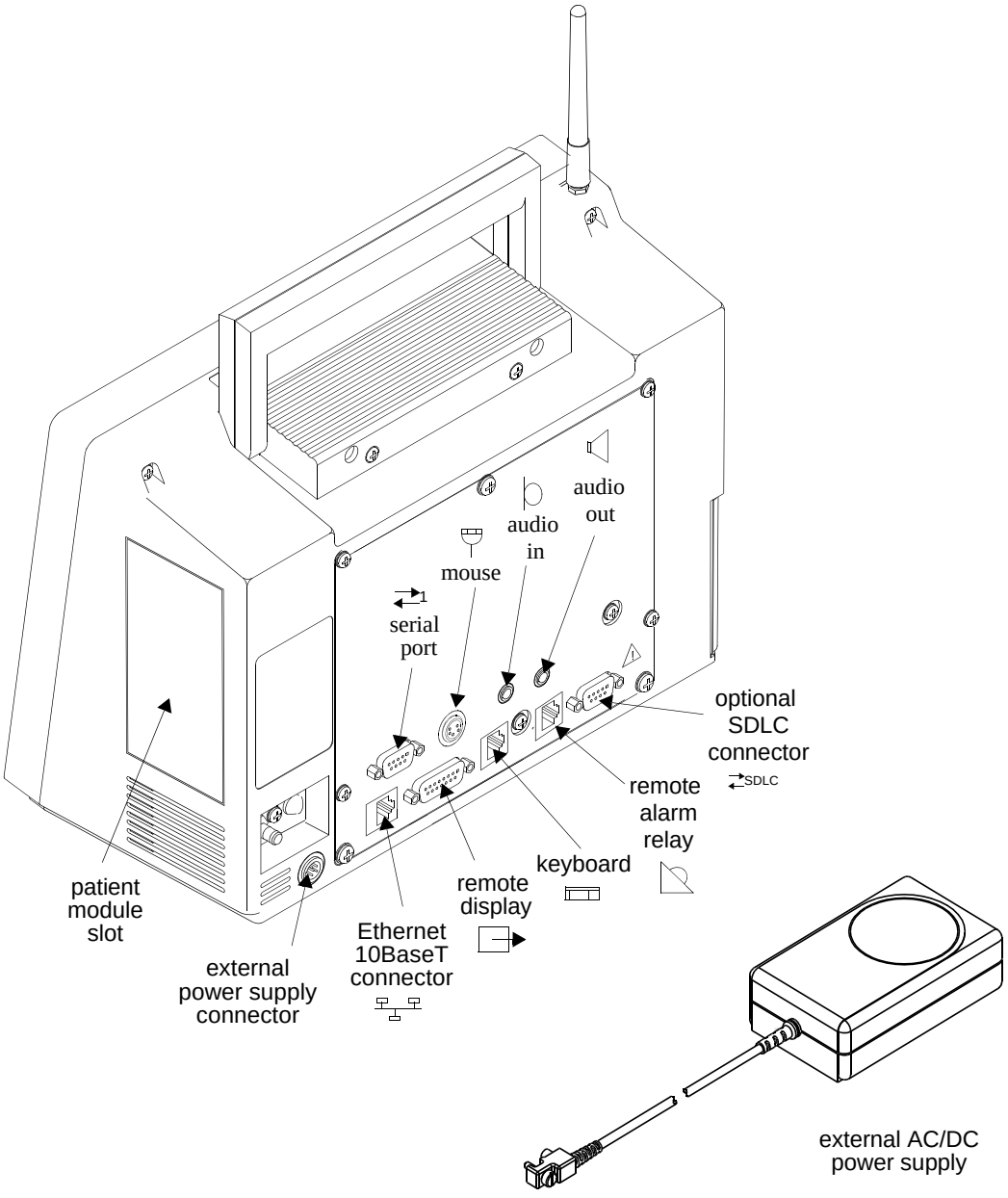


Figure 2-3: Power supply and optional SDLC connection

Caution:

Due to the options available on the 90367/90369 monitor, your rear panel may differ from the one illustrated above.

Installing the Optional Recorder Assembly

Caution:

Unless purchased separately for a monitor already in the field, the recorder option is installed at the factory. Order an upgrade from your local Sales Representative.

The recorder option is comprised of two components: the recorder module and the recorder CPU PCBA.

The recorder CPU PCBA and recorder module fit into the upper slot on the left side of the monitor (refer to *Figure 2-4*). The recorder CPU PCBA must be installed first, followed by the recorder module.

1. To install the recorder CPU PCBA (P/N 670-0625-00), power OFF the monitor, open the printer door, remove recorder hold cover, and insert the recorder CPU into the connector located at the bottom of the recorder compartment. After fully inserting the PCBA into the connector, tighten the thumbscrew to secure it to the bottom of the recorder compartment.
2. Install the insulator sheet.
3. Insert the recorder assembly (P/N 050-0064-00), ensuring that it fully engages the connector at the back of the recorder compartment. Press the release bar to open the recorder assembly. Tighten the two captive screws.

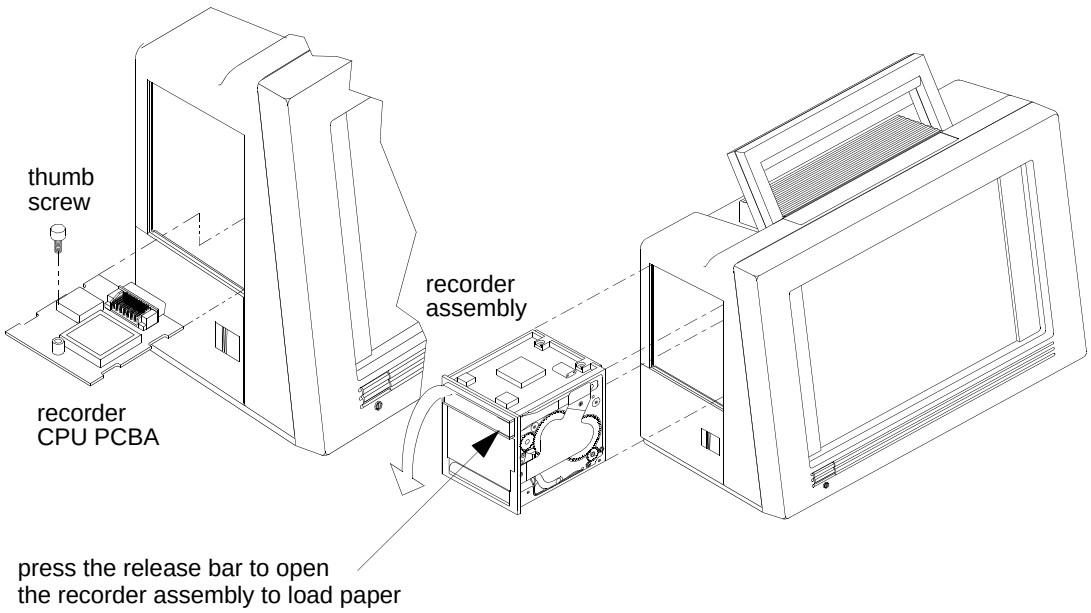


Figure 2-4: Recorder assembly and CPU

Inserting Recorder Paper

Two rolls of recorder thermal paper have been included with the recorder assembly option. To insert a roll of paper:

1. Press the right side of the release bar at the top of the recorder assembly. The front of the recorder assembly is hinged at the bottom and will drop open, revealing two spoon-shaped arms that hold the paper roll spindle between them.
2. Unroll a short length of paper from the roll, and orient the roll so that the paper feeds from the bottom.
3. Slip the paper roll spindle between the plastic arms, and close the front of the assembly so that the end of the paper roll protrudes out of the recorder assembly just below the release bar.

Power-ON Test

Each time the monitor is powered ON, internal system information is shown for approximately 10 seconds and keys are displayed on the screen. The monitor is now ready for normal operation.

External Devices

If an external SDLC device such as a Capnograph or other Flexport system interface is to be installed, the 9-pin connector on the rear of the remote module housing must be used. Only one external 9-pin port (the farthest from the monitor) can be used on a single bedside monitor. Even if multiple 9-pin SDLC ports on remote housings are available, only the one farthest from the monitor can be used for external devices. When this is the case, set the termination switch to OFF.

Cabling

Various cables and adapters are provided for interconnecting 90367/90369 monitor components. The following illustration provides an example of the types of cables used:

Designators **A** - **E** represent the various cables and adapters used. Refer to cable list for description.

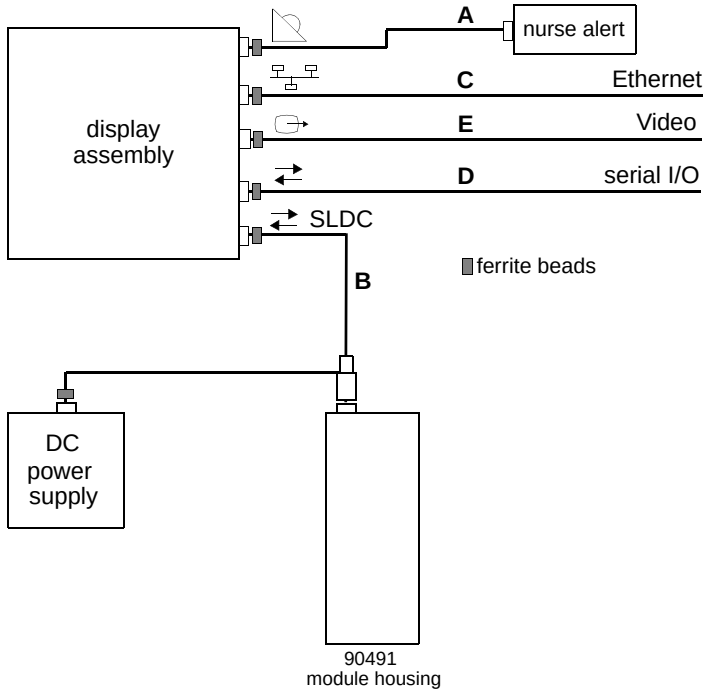


Figure 2-5: System cable block diagram

Caution:

Spacelabs Medical has tested and approved the cables listed in *Table 1* on page 2-10 for use with the 90367/90369 monitor. For continued EMI radiation compliance, use only these cables.

Cables and Adapters

Table 1: Cables and Adapters

Cable/ Adapter	Part Number	Description
A	012-0182-00	Cable, Shielded RS-232, Display, Alarm
B	012-0391-02	Cable, Display Assembly to Module Housing, 2' (0.61 m)
B	012-0391-04	Cable, Display Assembly to Module Housing, 4' (1.22 m)
B	012-0391-08	Cable, Display Assembly to Module Housing, 8' (2.44 m)
B	012-0391-10	Cable, Display Assembly to Module Housing, 10' (3.05 m)
C	175-0951-00	Cable, Assembly, Ethernet, 10BaseT, 3' (0.94 m)
C	175-0951-01	Cable, Assembly, Ethernet, 10BaseT, 6' (1.8 m)
C	175-0951-02	Cable, Assembly, Ethernet, 10BaseT, 12' (3.7 m)
C	175-0951-03	Cable, Assembly, Ethernet, 10BaseT, 20' (6.1 m)
D	012-0395-00	Cable, Display Assembly Serial Port (RS-232)
E	012-0584-00	Cable, Display Assembly, male DB15 to RGB, 6' (1.8 m)

Refer to *Parts* on page 6-1 for additional cable part numbers.

Maximum Cable Lengths

The following cables are limited to the indicated maximum length:

Ethernet Cable (10BaseT) — 326 feet (100 meters) maximum.

SDLC Cable — 40 feet (12.2 meters) maximum (total length from 90367/90369 monitor to last device on the bus). For longer SDLC cable runs, contact your local customer service representative.

Repeater Display Cable — 100 feet (30.5 meters) maximum (total length from 90367/90369 monitor to last repeater display).

Ethernet Cable

Bulk Cables

If desired, cables can be constructed from bulk 500 foot (152.4 meters) spools keeping in mind cables are 326 feet (100 meters) maximum. This type of cable construction would be preferable in cases where conduit lengths are unknown.

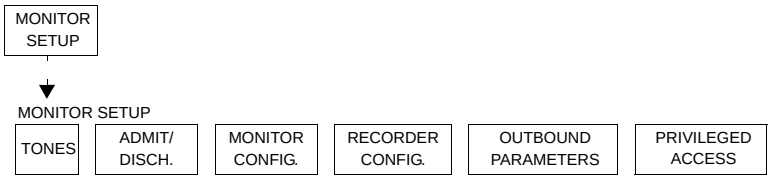
SDLC Cable Interconnection

A 9-pin connector with ferrite beads must be used. Refer to the *Module Housings and Power Supplies Service Manual* (P/N 070-0680-xx), located on CD-ROM 084-0700-xx.

Software Configuration

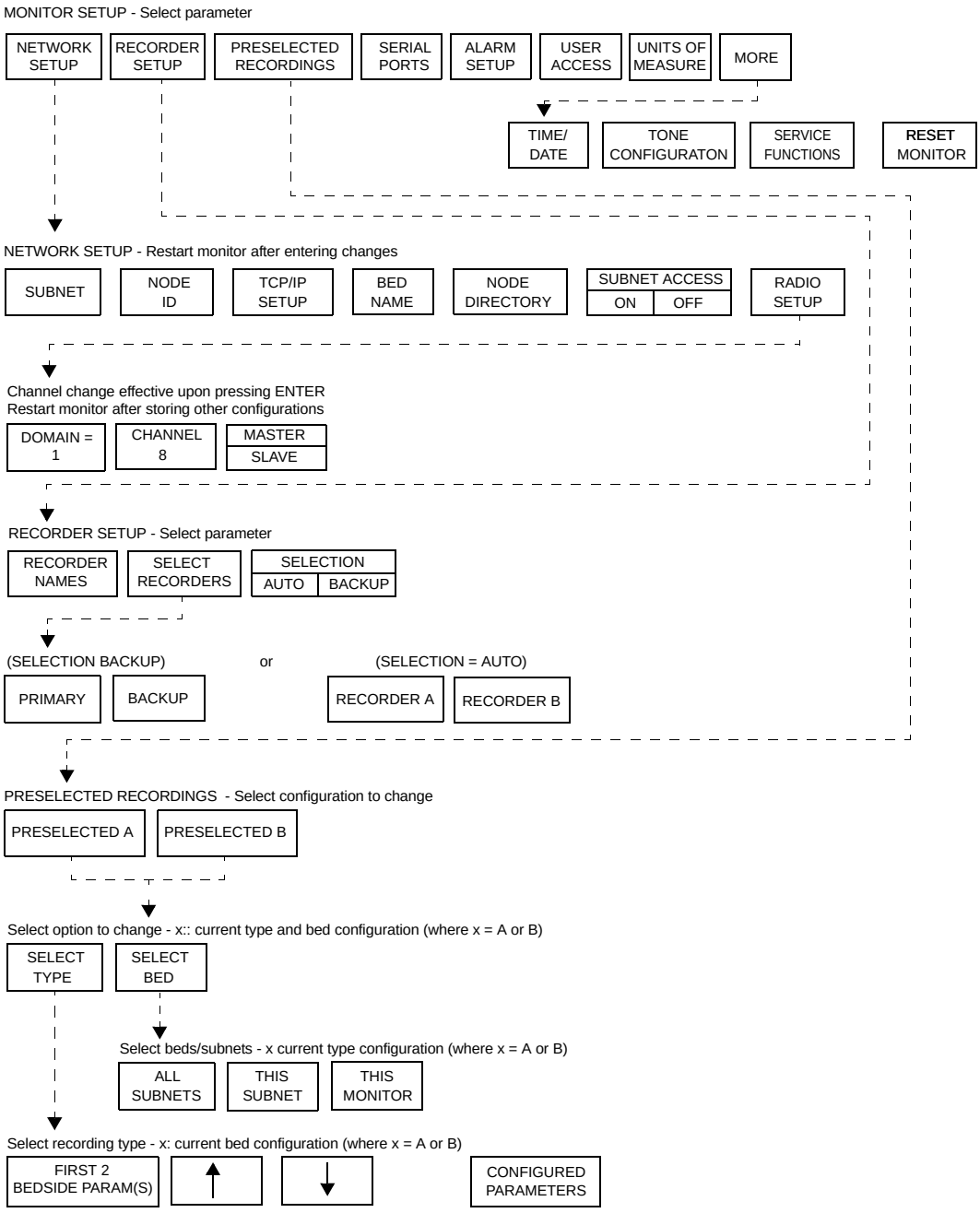
The **Biomed** menu enables an authorized service representative to set user defaults for monitor operation. To access the **Biomed** menu:

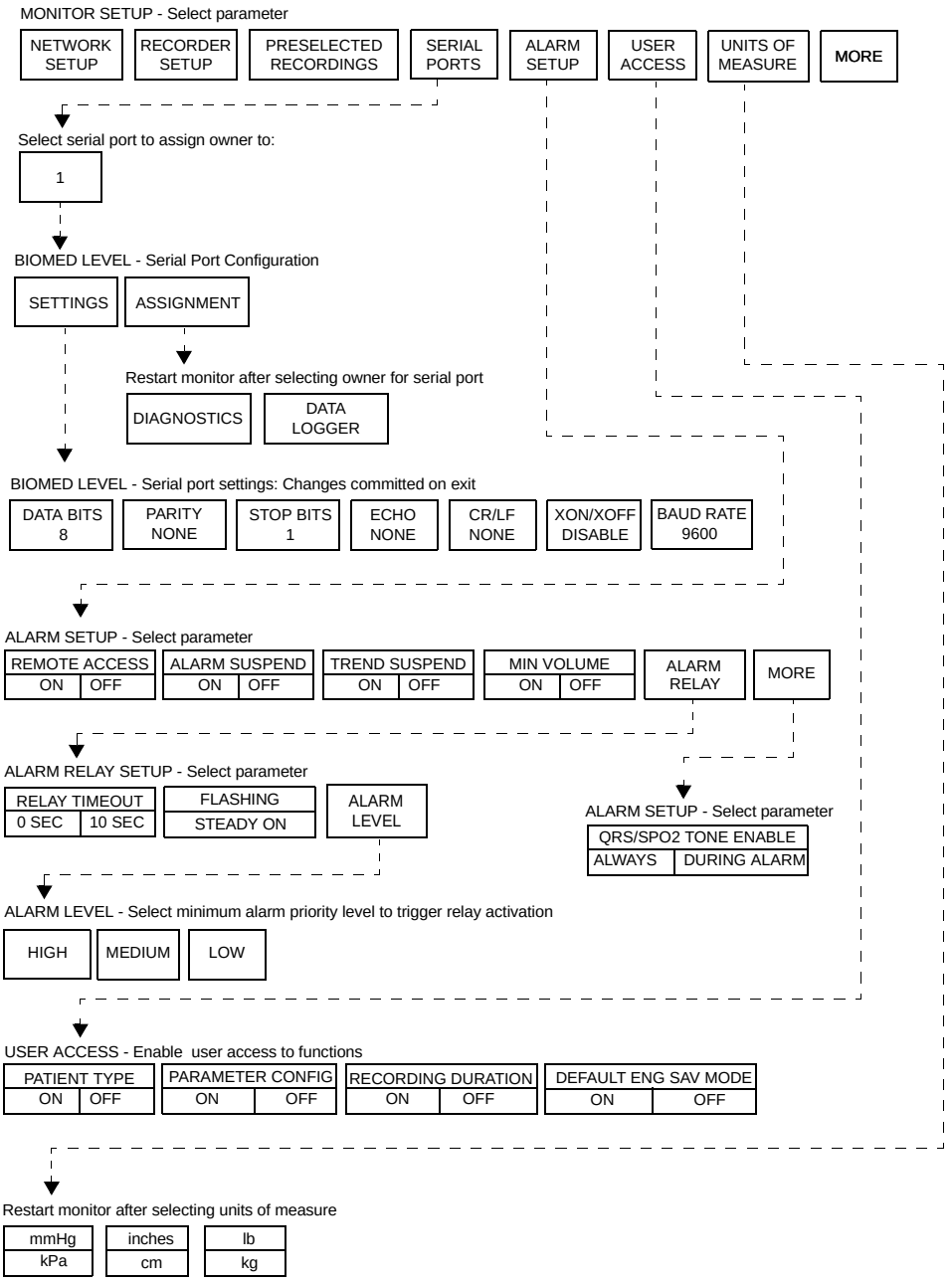
1 Press MONITOR SETUP.

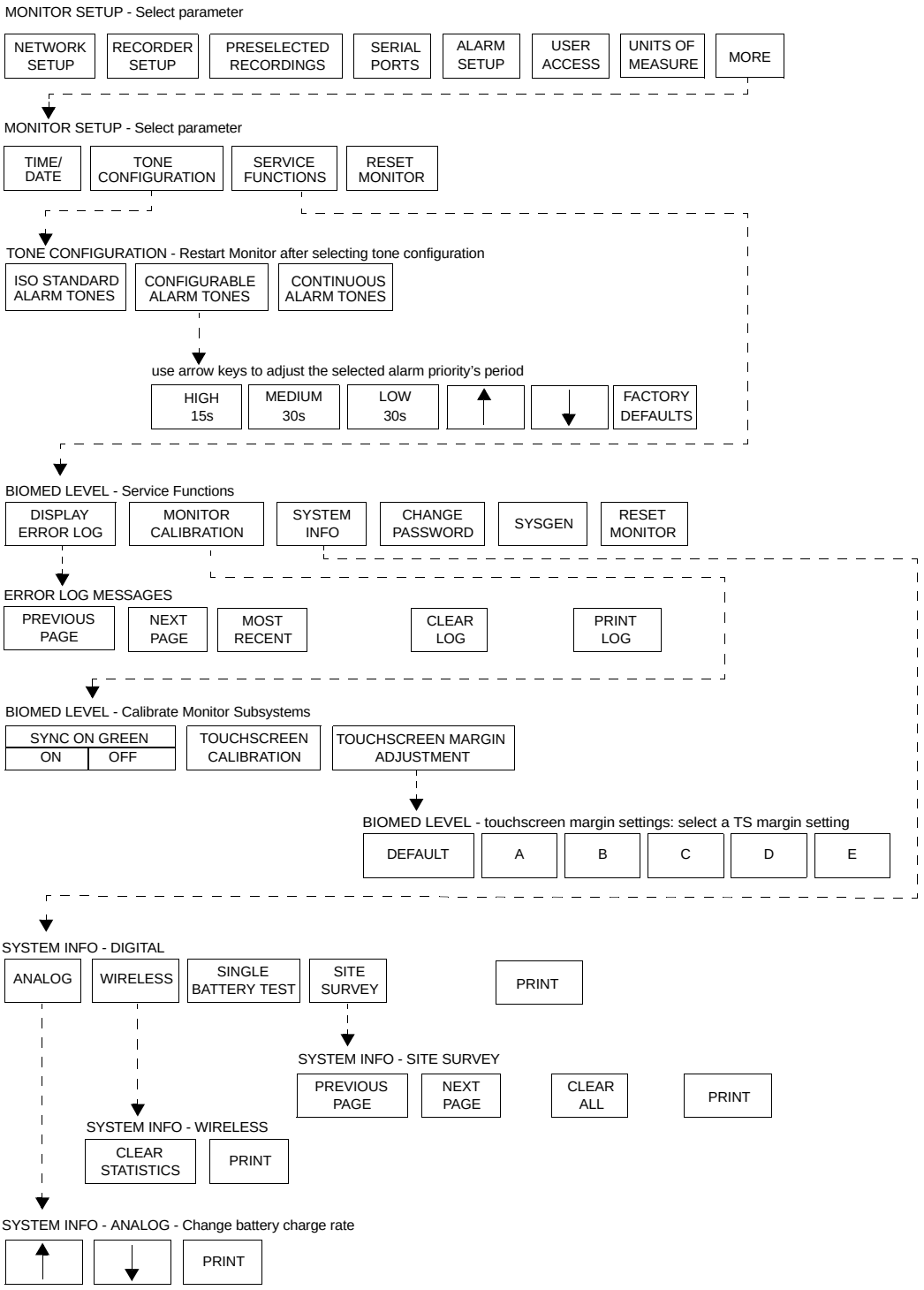


1 Touch PRIVILEGED ACCESS to display the **Keyboard** menu.

2 Enter the correct case-sensitive password to display the **Biomed Monitor Setup** menu:




MONITOR SETUP - Select parameter
NETWORK SETUP
RECORDER SETUP
PRESELECTED RECORDINGS
SERIAL PORTS
ALARM SETUP
USER ACCESS
UNITS OF MEASURE
MORE
Select serial port to assign owner to:
1
BIOMED LEVEL - Serial Port Configuration
SETTINGS
ASSIGNMENT
Restart monitor after selecting owner for serial port
DIAGNOSTICS
DATA LOGGER
BIOMED LEVEL - Serial port settings: Changes committed on exit
DATA BITS 8
PARITY NONE
STOP BITS 1
ECHO NONE
CR/LF NONE
XON/XOFF DISABLE
BAUD RATE 9600
ALARM SETUP - Select parameter
REMOTE ACCESS
ON
OFF
ALARM SUSPEND
ON
OFF
TREND SUSPEND
ON
OFF
MIN VOLUME
ON
OFF
ALARM RELAY
MORE
ALARM RELAY SETUP - Select parameter
RELAY TIMEOUT
0 SEC
10 SEC
FLASHING
STEADY ON
ALARM LEVEL
ALARM SETUP - Select parameter
QRS/SPO2 TONE ENABLE
ALWAYS
DURING ALARM
ALARM LEVEL - Select minimum alarm priority level to trigger relay activation
HIGH
MEDIUM
LOW
USER ACCESS - Enable user access to functions
PATIENT TYPE
ON
OFF
PARAMETER CONFIG
ON
OFF
RECORDING DURATION
ON
OFF
DEFAULT ENG SAV MODE
ON
OFF
Restart monitor after selecting units of measure
mmHg
kPa
inches
cm
lb
kg


MONITOR SETUP - Select parameter
NETWORK SETUP
RECORDER SETUP
PRESELECTED RECORDINGS
SERIAL PORTS
ALARM SETUP
USER ACCESS
UNITS OF MEASURE
MORE
MONITOR SETUP - Select parameter
TIME/ DATE
TONE CONFIGURATION
SERVICE FUNCTIONS
RESET MONITOR
TONE CONFIGURATION - Restart Monitor after selecting tone configuration
ISO STANDARD ALARM TONES
CONFIGURABLE ALARM TONES
CONTINUOUS ALARM TONES
use arrow keys to adjust the selected alarm priority's period
HIGH 15s
MEDIUM 30s
LOW 30s
FACTORY DEFAULTS
BIOMED LEVEL - Service Functions
DISPLAY ERROR LOG
MONITOR CALIBRATION
SYSTEM INFO
CHANGE PASSWORD
SYSGEN
RESET MONITOR
ERROR LOG MESSAGES
PREVIOUS PAGE
NEXT PAGE
MOST RECENT
CLEAR LOG
PRINT LOG
BIOMED LEVEL - Calibrate Monitor Subsystems
SYNC ON GREEN
ON
OFF
TOUCHSCREEN CALIBRATION
TOUCHSCREEN MARGIN ADJUSTMENT
BIOMED LEVEL - touchscreen margin settings: select a TS margin setting
DEFAULT
A
B
C
D
E
SYSTEM INFO - DIGITAL
ANALOG
WIRELESS
SINGLE BATTERY TEST
SITE SURVEY
PRINT
SYSTEM INFO - SITE SURVEY
PREVIOUS PAGE
NEXT PAGE
CLEAR ALL
PRINT
SYSTEM INFO - WIRELESS
CLEAR STATISTICS
PRINT
SYSTEM INFO - ANALOG - Change battery charge rate
PRINT

Keyboard Menu

The **Keyboard** menu appears whenever a menu is selected that requires entering alphanumeric data (A-Z, 0-9).

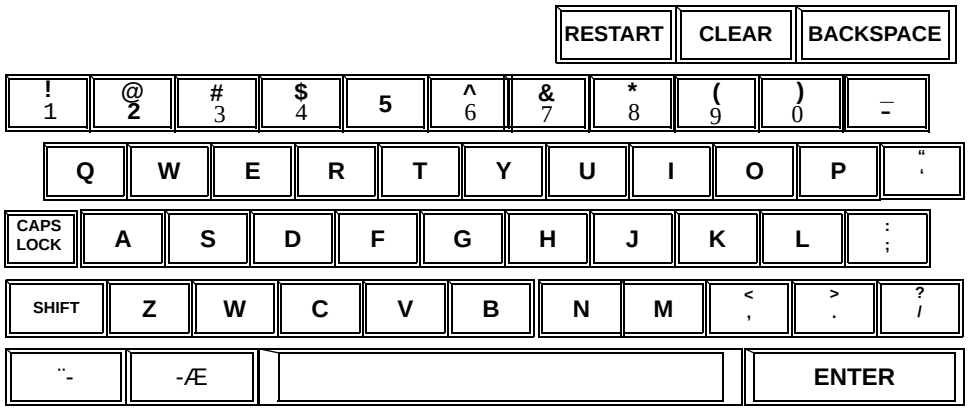


Figure 2-6: Pop-up keyboard menu

When the keyboard first appears, the cursor is positioned at the first character in the input line and moves through the input line as you press the keys. Input changes are displayed on the prompt line but are not acknowledged by the monitor until you touch the ENTER key.

When you select a character key and the cursor is located at the last character in the name, the cursor remains in place but types over the old character with the new character.

Use the DEL key to remove the character under the cursor and shift the remaining characters one position to the left.

Use the ← key to move the cursor one position to the left. If the cursor is at the first character in the name, no change occurs.

Use the → key to move the cursor one position to the right. If the cursor is at the last character in the line, no change occurs.

Caution:

When using the left and right arrow keys, the text is written over and is not inserted.

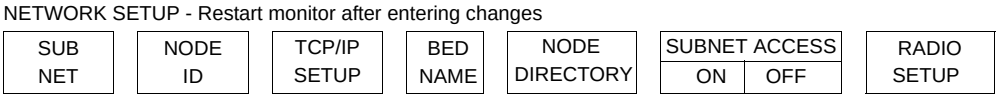
Use the RESTART key to display the last name recognized by the system. Any changes that have not been stored in memory (by pressing ENTER) are deleted.

Use the CLEAR key to delete the displayed characters, enabling you to enter new ones.

Biomed Setup Keys

NETWORK SETUP Key

The **Network Setup** key enables you to define a subnet name, node ID, and bed name; view the active nodes on the network and select an appropriate subnet access level. Touch NETWORK SETUP to display the following menu:



SUBNET Key

Touch SUBNET to display the **Keyboard** menu that enables you to key in a subnet name (refer to *Keyboard Menu* on page 2-15 for instructions on use). This name can contain up to five characters, letters, or numbers.

To enter a subnet name:

1. Touch SUBNET.
2. Type in the subnet name.
3. When you have entered the name correctly, touch ENTER to store the name in memory.
4. Reset the monitor so that the network can recognize the new name.

NODE ID Key

Touch the NODE ID key to display the pop-up keyboard (refer to *Figure 2-6* on page 2-15).

Each monitor on the network must have a unique node ID. The default node ID for an un-initialized monitor is **1**. You must change this ID to allow the monitor to function properly on the network. After changing the ID, you must reset the monitor to enable the system to recognize the new node ID.

To enter a node ID:

1. Touch NODE ID.
2. Enter a number between 1 to 64 (1 to 250 with monitors that support the Expanded Network).
3. When you have entered the Node ID correctly, touch ENTER on the keypad to store the value in memory.
4. Reset the monitor so that the network recognizes the new Node ID.

TCP/IP Setup Key

Touch TCP/IP SETUP to display the **Keyboard** menu (refer to *Figure 2-6* on page 2-15) and key in a TCP/IP address (refer to the *Keyboard Menu* on page 2-15 further instructions). Touch ENTER to initiate error checking and verify that the address is in the proper xxx.xx.xxx.xxx format.

To enter a TCP/IP address:

1. Touch TCP/IP SETUP.
2. Type in the TCP/IP address.
3. When you have entered the TCP/IP address correctly, touch ENTER to store the address in memory.
4. Reset the monitor to have the network recognize the new TCP/IP address.

Entering an invalid IP address (e.g., 89.0.3.22x) sounds an error tone and displays the message
`IP address 89.0.3.22x is out of range or invalid`

BED NAME Key

When the BED NAME key is touched, the monitor displays the **Keyboard** menu (refer to *Figure 2-6*). Use the keys on the **Keyboard** menu to enter the bed name assigned to the monitor. This bed name is also the monitor's node name on the network and is limited to five characters.

The message **Restart monitor after change in bed name: xxxxx** is displayed when you touch BED NAME. The **xxxxx** is the node name currently recognized by the network. The name you enter can contain from one to five alphanumeric characters but must be unique to the network. Reset the monitor after you enter the bed name to allow the network to recognize the new name.

To enter a bed name:

1. Touch BEDNAME.
2. Type in the bed name.
3. When you have entered the name correctly, touch ENTER to store the bed name into memory.
4. Reset the monitor so that the network recognizes the new bed name.

NODE DIRECTORY Key

The NODE DIRECTORY key enables you to view which nodes are active on the network. Touching this key displays a set of node keys identifying the bed name (top) and the subnet where it belongs (bottom):

Nodes active on the network

BED01 WARD1	BED02 WARD1	**BED03 WARD1**	BED04 WARD1	BED05 WARD1	CEN01 ICU

(The bed names are provided as examples.)

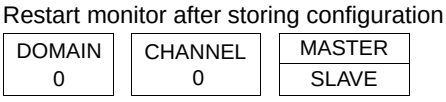
SUBNET ACCESS Key

The SUBNET ACCESS key limits this monitor's accessibility to beds physically located on other subnets. When Subnet Access is OFF, the monitor can access only those beds attached to its own subnet. When Subnet Access is ON, the monitor can also access beds located on other subnets.

To set Subnet Access to OFF:

1. Set SUBNET ACCESS to OFF.
2. Power the monitor OFF and ON again to ensure that all alarm watches, zone assignments, and remote views are cleared.
3. Set the remote views (bedside monitors) as desired.
4. Select RECORDERS using only the recorders on the local subnet and set PRESELECTED RECORDINGS to access only the monitors in the local subnet.
5. Set ALARM WATCHES as desired.

RADIO SETUP Menu Tree



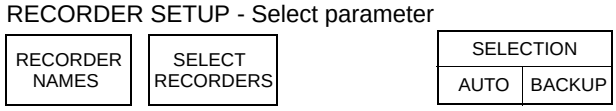
RADIO SETUP Menu — This key is only displayed on wireless monitors if the radio is present. Whenever the monitor powers ON and the network cable is not connected, the radio signs on and the sign on message is displayed on the monitor's prompt message line. (The sign on message also displays within 10 seconds after any change made within this menu.)

DOMAIN XX and CHANNEL XX — The lower lines of these keys display the monitor's current settings for the radio's domain (0) and channel (1). Selecting either of these keys highlights that key, dims the other key, and displays the pop-up keypad. Selecting the keypad's ENTER key stores the currently displayed settings in the monitor's non-volatile memory and restarts the radio.

MASTER/SLAVE — This key selects whether the monitor's radio is configured as a wireless network master or slave. The current setting is highlighted and is stored in the monitor's non-volatile memory. Whenever it is changed, the radio is restarted.

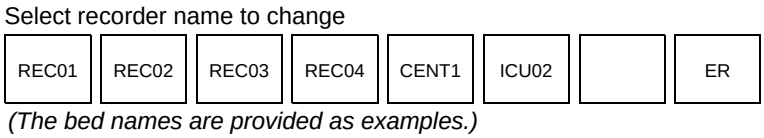
RECORDER SETUP Key

Touching the RECORDER SETUP key displays the following menu:



RECORDER NAMES Key

The RECORDER NAMES key enables you to assign names to each recorder on the system. Touching RECORDER NAMES displays the following information:



(The bed names are provided as examples.)

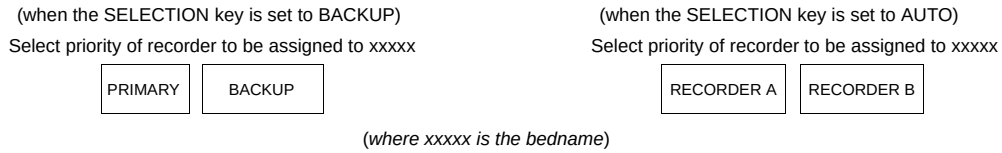
When touched, the **Keyboard** menu appears (refer to *Figure 2-6* on page 2-15), enabling you to enter or change the name. Each name can contain from one to five characters.

To change a recorder name:

1. Touch the recorder key that you want to change or touch a blank key to add another recorder.
2. Enter the name of the recorder.
3. When you have entered the name correctly, touch ENTER to store the name into memory.

SELECT RECORDERS Key

The SELECT RECORDERS key enables you to assign a priority to system recorders for each bed. Touching this key displays the following menu:


(when the SELECTION key is set to BACKUP)
Select priority of recorder to be assigned to xxxxx
PRIMARY
BACKUP
(when the SELECTION key is set to AUTO)
Select priority of recorder to be assigned to xxxxx
RECORDER A
RECORDER B

(*where xxxxx is the bedname*)

Caution:

The AUTO selection considers paper usage in determining the destination of the recording. The BACKUP selection always selects the PRIMARY recorder, unless it is either unavailable or unable to print recording.

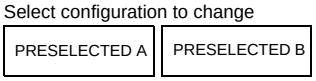
1. Touch one of the above keys to display a list of available system recorders.
2. Touch the recorder name key assigned to the bed as either primary or backup (depending upon your choice in step 1).
3. Touch PREVIOUS MENU to return to one of the **Select Priority** menus.
4. Repeat steps 1 through 3 to assign the remaining recorder(s).

PRESELECTED RECORDINGS Key

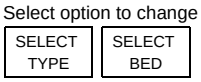
The PRESELECTED RECORDINGS key enables you to define which beds and parameters will be automatically recorded when the user touches the PRESELECTED A and PRESELECTED B keys in the **Recorder** menu.

To define the PRESELECTED A and B keys:

1 Touch PRESELECTED RECORDINGS to display the keys:



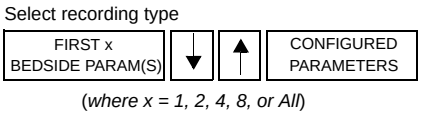
2 Touch the key to be defined (A or B). The following keys appear:



SELECT TYPE enables you to choose which parameters for the selected bed(s) will be recorded.

SELECT BED enables you to choose which bed(s) will have the selected parameter sent to the recorder.

Touch SELECT TYPE to display the following menu:



This menu enables you to choose to record either the first few parameters for the bed, all the parameters on this bed, or only specified parameters.

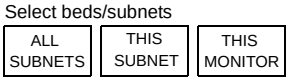
3 Touch FIRST x BEDSIDE PARAM(S).

4 Use the arrow keys to cycle through the parameter selections: ALL BEDSIDE PARAM(S) or FIRST n BEDSIDE PARAM(S) (where n is 1, 2, 4, or 8).

5 Touch CONFIGURED PARAMETERS to display a menu of parameter keys that can be selected (ON or OFF) for recordings.

6 Touch PREVIOUS MENU to return to the SELECT TYPE and SELECT BEDS keys.

7 Touch SELECT BEDS to define which beds will be included in the pre-configured recordings. The following keys appear:



ALL SUBNETS includes all the beds on all subnets.

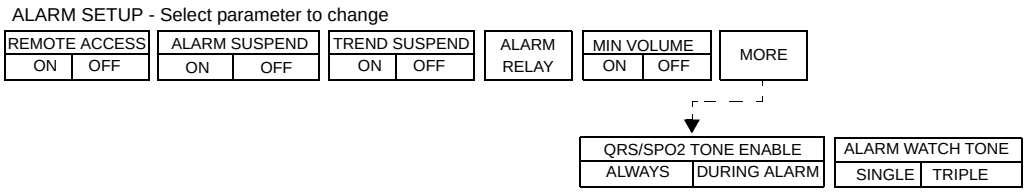
THIS SUBNET includes all the beds on this subnet.

THIS MONITOR includes all the parameters on this monitor.

1. Touch the appropriate option.
2. Return to step 1 to define the remaining pre-selected recordings.

ALARM SETUP Key

The ALARM SETUP key enables you to configure the alarm features. Touching this key displays the **Alarm Setup** menu:



REMOTE ACCESS ON/OFF Key

The REMOTE ACCESS ON/OFF key enables (ON) or disables (OFF) a remote monitor's access to this monitor's alarm limits.

ALARM SUSPEND ON/OFF Key

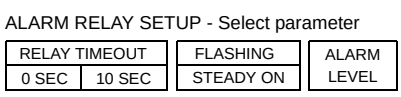
The ALARM SUSPEND ON/OFF key enables (ON) or disables (OFF) operation of the monitor's alarm suspend function. With the key ON, ALARM SUSPEND will be displayed on the key. With the key OFF, TONE RESET will be displayed on the key.

TREND SUSPEND ON/OFF Key

When the TREND SUSPEND ON/OFF key is set to ON, trending is disabled when alarms are suspended using the **Alarm Suspend** hard key. When this key is set to OFF, trending operation becomes independent of the **Alarm Suspend** hard key (i.e., the key will always trend when a parameter is active).

ALARM RELAY Key

Touching ALARM RELAY displays the **Alarm Relay Setup** menu:



RELAY TIME-OUT 0 SEC/10 SEC Key

The RELAY TIME-OUT key sets the number of seconds (0 or 10) that the alarm relay remains closed following the end of an alarm condition.

FLASHING/STEADY ON Key

The FLASHING/STEADY ON key selects the mode of operation for the alarm relay ( ). In FLASHING mode, the alarm relay contacts open and close according to the priority of the active alarm level. In the STEADY ON mode, the relay contacts close if any alarms are active. They open only when all alarm conditions cease.

ALARM LEVEL Key

The ALARM LEVEL key defines the level of alarms responded to by the monitor (activate alarm relay): high, medium, or low. Touching ALARM LEVEL displays the **Alarm Level** menu:

ALARM LEVEL - select minimum alarm priority level to trigger relay activation

HIGH	MEDIUM	LOW

Select HIGH to monitor only high priority alarms.

Select MEDIUM to monitor medium and high priority alarms.

Select LOW to monitor all alarm priorities (high, medium, and low).

MINIMUM VOLUME ON/OFF Key

The MINIMUM VOLUME ON/OFF key locks (ON) the current alarm tone volumes as the new minimum volumes or unlocks (OFF) the tone volume controls.

QRS/SPO2 TONE ENABLE Key

The QRS/SPO2 TONE ENABLE key defines whether the QRS or SpO_2 tones, when enabled within the **ECG** or **SPO2** menus, sound all the time (Always) or only when this monitor is in alarm (During Alarm).

ALARM WATCH TONE Key

The ALARM WATCH TONE key defines whether the alarm watch notification tone sounds once or three times whenever this monitor receives a new alarm watch multicast message.

UNITS OF MEASURE Key

Touch the UNITS OF MEASURE key to select a unit of measure for the monitor:

Restart monitor after selecting units of measurement

mmHg	inches	lb
kPa	cm	Kg

The highlighted option is the one that is currently active. Touching another key changes the selection.

USER ACCESS Key

The USER ACCESS key provides privileged users access to enable certain functions for normal use.

USER ACCESS - Select user access-to functions

PATIENT TYPE		PARAMETER CONFIGURATION		RECORDING DURATION		DEFAULT ENG SAVE MODE	
ON	OFF	ON	OFF	ON	OFF	ON	OFF

The highlighted option is the one that is currently active. Touching another key changes the selection.

PATIENT TYPE ON enable Adult/Neonate selection in the **Monitor Setup** menu. PARAMETER CONFIGURATION ON displays the parameter configuration key in the **Monitor Configuration** menu.

For example, the RECORDING DURATION ON/OFF key controls user access to the recording duration feature. When set to ON, the RECORDING DURATION key appears in the **Recorder Configuration** menu. It does not appear when OFF.

The DEFAULT ENG SAVE MODE key sets the default key position (ON or OFF) of the ENERGY SAVING MODE key in the **Monitor Configuration** menu. The ENERGY SAVING MODE key is present only while operating on batteries.

TONE CONFIGURATION Menu Tree

The TONE CONFIGURATION menu enables the operator to configure the monitor's alarm tone configuration.

TONE CONFIGURATION - Restart the monitor after selecting tone configuration

ISO STANDARD ALARM TONES	CONFIGURATION ALARM TONES	CONTINUOUS ALARM TONES

The active option will be highlighted.

Touch the CONFIGURABLE ALARM TONES key to display the following menu.

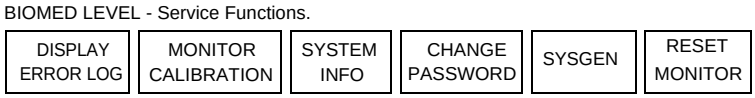
Use the arrow keys to adjust the priority period of the selected alarm

HIGH 15s	MEDIUM 30s	LOW 30s	↓	↑	FACTORY DEFAULTS

This menu enables the operator to configure the monitor's alarm tones to have different repetition rates than are defined in the ISO standard.

SERVICE FUNCTIONS Menu

This menu provides the operator with the capability to review system information and calibrate the monitor's display subsystem.

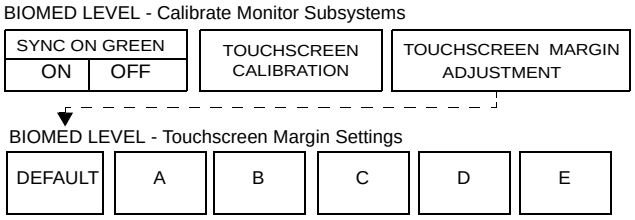


DISPLAY ERROR LOG Key

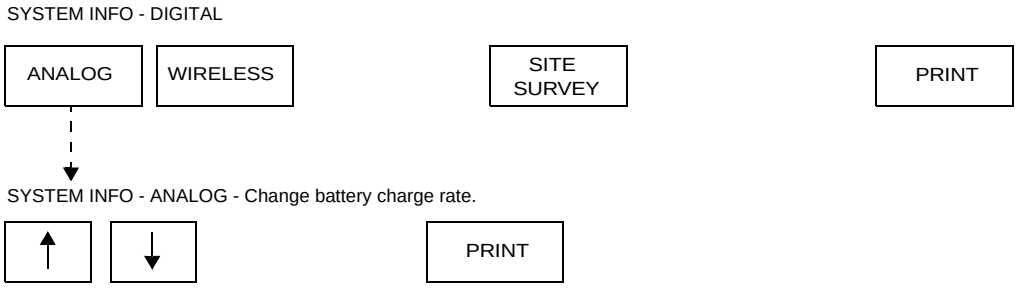
The DISPLAY ERROR LOG key enables you to display the monitor's logged errors. Keys in this menu enable you to page backwards or forwards through the error log, display the most recent page of logged errors, clear the log, and print the log's currently displayed page.

MONITOR CALIBRATION Menu Tree

The **Monitor Calibration** menu tree provides the operator with the capability to calibrate various monitor subsystems.



SYSTEM INFORMATION Menu Tree



When this menu is displayed, the monitor's digital information screen is displayed. Horizontal dividing lines above and below this display separate it from other information.

ANALOG Key

Selecting the ANALOG key displays the battery charge rate menu and its displays. Two different displays exist, one when the monitor is connected to AC power, the other when the monitor is not.

```
                     voltage      %full    AC/DC
batteries (A & B)    *******       ***      AC

battery charge current(A)    :    1.30
battery resistance(KOhms)    :   1.860
battery charge rate          : Calculated

3.3V power used (W)          :    2.50
5V power used (W)            :    7.25
+/-12V power used (W)        :   10.30
Total power used (W)         :   20.050

power supply temperature (C)  :   46
digital temperature           :   42

line voltage (V)              :   17.411
```

with AC power

```
                     voltage      %full    AC/DC
batteries (A & B)     10.619         10     DC

battery charge current(A)    :    ****
battery resistance (KOhms)   :    ****
battery charge rate          : **********

3.3V power used  (W)         :    2.50
5V power used  (W)           :    6.18
+/-12V power used (W)        :   12.71
Total power used (W)         :   22.64

power supply temperature (C)  :   46
digital temperature           :   40

line voltage (V)              :   ******
```

without AC power

WIRELESS Key

CLEAR STATISTICS

PRINT

Selecting the WIRELESS key displays the wireless information screen and menu. The radio statistics are displayed about this menu. CLEAR STATISTICS clears the statistics in the radio (which are currently displayed), restarts the radio, and updates this screen. “No statistics” may be displayed depending on the timing of this screen update. The PRINT button prints all the information displayed on the screen. The PRINT key enables you to print all the information displayed on the screen.

SITE SURVEY Key

The SITE SURVEY key is disabled if the radio is not running. This key displays this monitor's site survey screen and menu. The following illustrates this screen's display on any of the Ultraview 1030/1050 monitors. The channel line and the current page number are displayed in the upper right of the display. CLEAR ALL clears the display.

```
            Channel 08                                                Page 1
 Master:
       MAC          Node    Bed Name    Signal
 *  0020A6203FC9       2      02VIP       178
 *                     7      07VIP       178
 *                    14      14PCS       166
                 .
                 .
                 .
 *                    25      25VIP       166

 Slave:
       MAC          Node    Bed Name    Signal
 *  0020A62024CF      10      010R        177
 *  0020A6203FCC      12      12VIP       178
                 .
                 .
                 .
 *  0020A6203FC9      45      045RB       179
```

PRINT Key

Selecting this key prints the display.

CHANGE PASSWORD Key

The CHANGE PASSWORD key enables you to change the password that allows access to the **Privileged Access** menus.

To set or change the password:

1. Select the CHANGE PASSWORD key to display the on-screen keyboard and the password prompts.
2. Key in your new password (9 characters maximum) at the **New Password:** ___ prompt. Select ENTER.
3. Enter this new password a second time at the **Verify Password:** __ prompt. Select ENTER.

RESET MONITOR Key

Touch the RESET MONITOR key to reset the monitor after changing configuration settings, etc. You will not lose patient data when resetting from this key.

Updating Flash PROM

Note:

Updating Flash PROM is only accomplished by Spacelabs Medical personnel.

Network Configuration

Figure 2-7 illustrates a typical network system composed of bedside monitors, central monitors, and a clinical information system.

Typical Wired Network Configuration

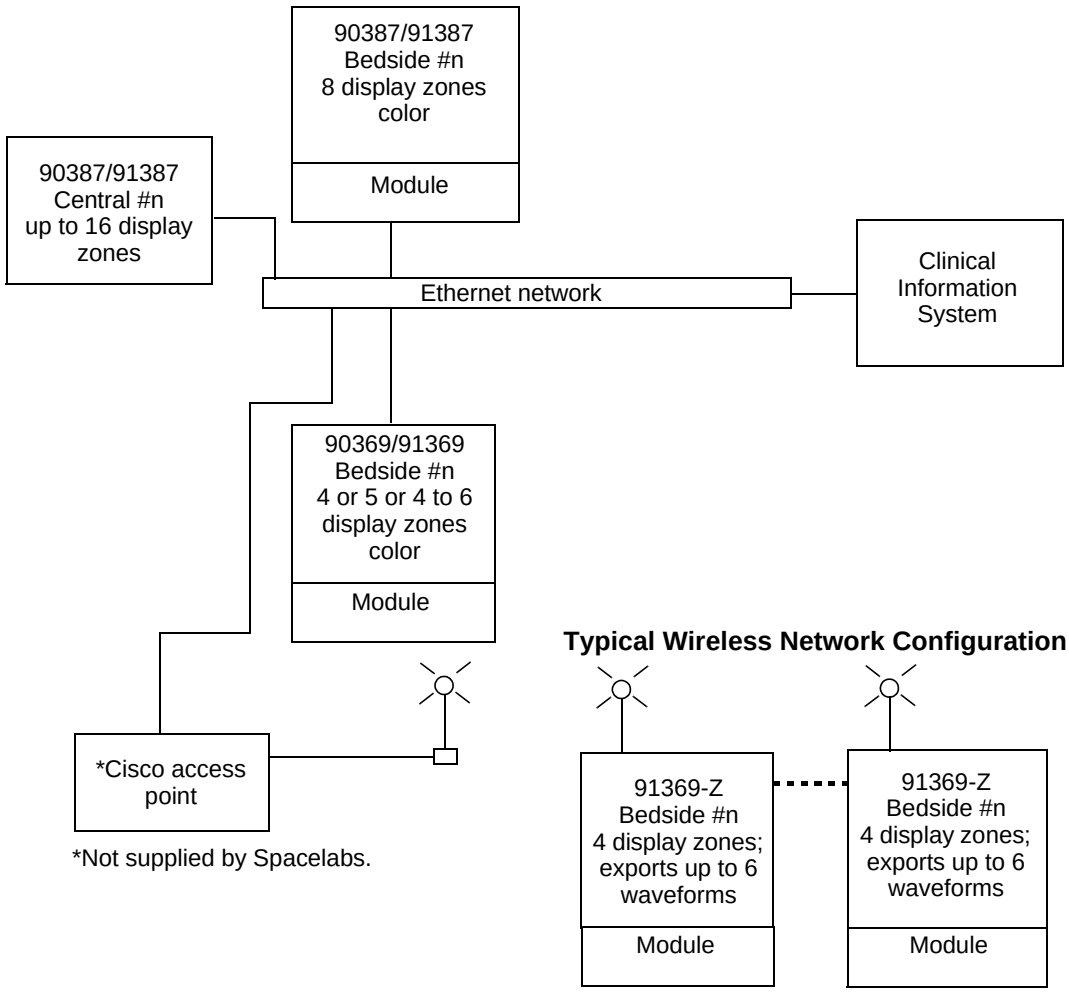


Figure 2-7: Typical wired network configuration

Warning:

Ensure that the Ethernet wall plate and the shield of the Ethernet connecting cable are bonded to the hospital grounding system.

Ethernet Installation

Caution:

Only qualified personnel should attempt to install a monitor to an Ethernet LAN.

Note:

Detailed installation instructions for an Ethernet local area network (LAN) are beyond the scope of this document.

Install the monitor on a suitable table or shelf, ensuring that the air flow to the side air intake vents is unobstructed, or use a Spacelabs Medical wall mount (P/N 016-0347-xx).

To connect the monitor to the Spacelabs Medical Ethernet LAN:

1. Plug the power cord attached to the monitor's DC power supply into a standard hospital-grade AC power source.
2. Turn the monitor power ON.
3. Enter a unique NODE ID, BED NAME, and SUBNET for the monitor. Refer to *Software Configuration* on page 2-11 for more information.

Note:

Do not connect the monitor to an Ethernet LAN prior to configuring the network parameters. The monitor must be properly configured for LAN access before you operate the monitor. If you fail to correctly configure the monitor, you may interrupt other units also using the LAN.

4. Attach the 10Base-T LAN transceiver cable into the phone-type connector on the rear panel of the monitor.
5. Reconfigure the network to accept the monitor connection to the Ethernet LAN.

Ethernet Removal

1. To remove a monitor from the local area network, disconnect the Ethernet cable from the Ethernet connection ( ).

Module Tests

To verify that the monitor functions correctly with parameter modules:

1. Insert a 90496 module without the patient cables connected.
   - Verify that the vertical ECG screen appears and displays **???** and the message **LEADS OFF**.
2. Connect a waveform simulator to the ECG input with a 5-lead patient cable and set the simulator to a known rate.
   - Verify that the ECG count and lead being monitored are displayed to the right of the ECG parameter key.

- Verify that the ECG waveform is displayed.

3 Connect a waveform simulator to the pressure inputs.

4 Label and zero the channels.

- Verify that the numerics and waveforms are accurate.

5 Touch RECORD, then touch one of the flashing parameter keys.

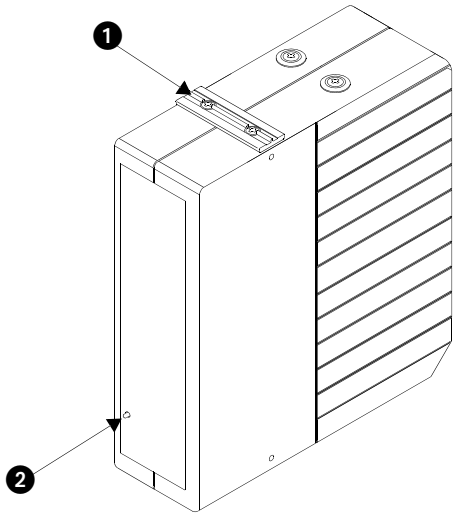
- Verify that the recording is printed.

Note:

If the monitor is installed on a network, perform this test as described. Verify that the recordings are printed at the central printer.

Optional 90310 Wireless Network Interface (WNI)

90310 Front Panel



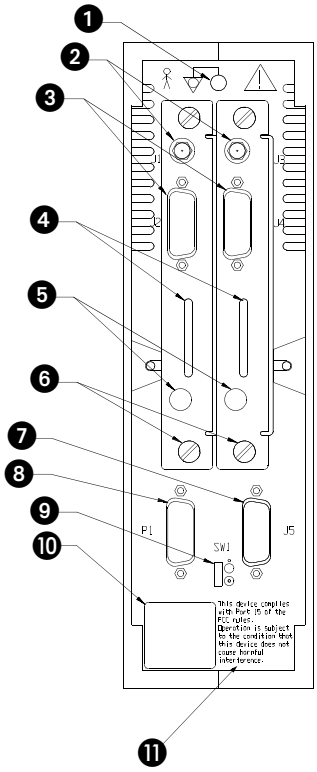
❶ Rack mounting hardware — mounts the 90310 housing onto the housing pedestal mounts

Single housing kit (P/N 016-0365-00)

Double housing kit (P/N 016-0364-00)

❷ Power LED — when lit, indicates the presence of DC voltage to the 90310

90310 Rear Panel



1. Ground lug — available for any chassis grounding requirements
2. Antenna connectors (J1, J3) — screw-on connectors that attach to the pedestal mount antenna
3. Ethernet connectors (J2, J4) — connect the 90310 to a Spacelabs Medical network
4. Status LEDs — displays hexadecimal code for errors detected during power up diagnostics. Displays the channel selection during normal operation
5. Channel selection thumb wheel — selects the communication channel. Both the 90310 and Ultraview 1030/1050 must select the same channel to communicate
6. Captive thumbscrews (4) — secure the PCBA to the 90310 assembly. May be hand-tightened
7. SDLC/power out (J5)
8. SDLC/power in (P1)
9. Terminator switch (SW1) — the last daisy-chained 90310 from the power supply must have this switch enabled (down). All others in this chain are disabled (up)
10. Model and serial number ID label
11. FCC label

Configuration Options for Wireless Ethernet Option (90310)

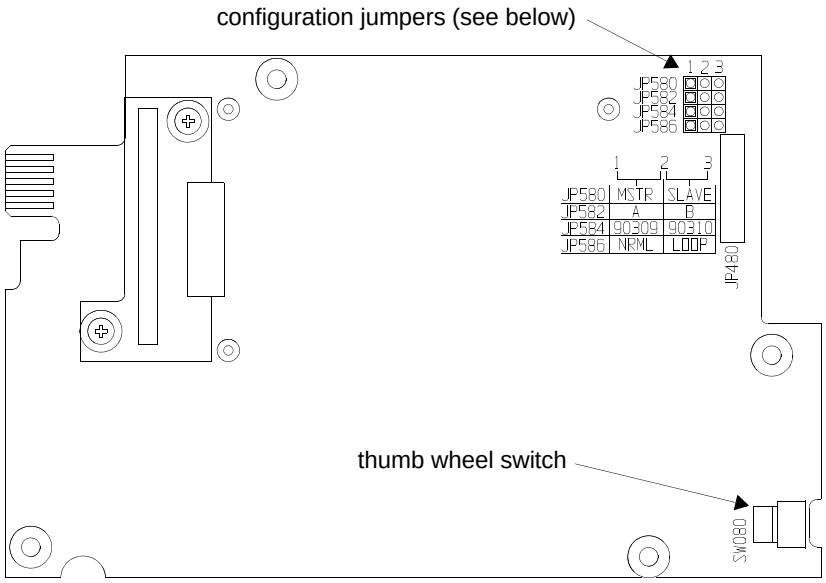


Figure 2-8: 90310 Wireless Ethernet Interface PCBA

Master/Slave

Selects if 90310 is configured as a master or slave monitor. Only one master unit is allowed per channel selection.

A/B

Unused

90309/90310

Defines the unit where the wireless PCBA is installed.

Normal/Loop

Configures the diagnostics mode. In “normal”, only one diagnostics pass is completed. In “loop”, diagnostics will loop continuously after displaying error conditions.

Thumb Wheel Switch

Configures the network channel number. There are 16 positions, 0 through F. 0 allows the unit to roam to the first available master. 1 through F identify a specific network channel.

Contents

Overview 1
DC Power Supply 2
Parameter Module 2
Optional Capnography 2
90367/90369 Monitor 3

Overview

A typical 90367/90369 system consists of these major components:

- 90367/90369 Monitor
- DC Power Supply
- Parameter Module
- Optional Capnography

There may also be additional hardware devices present, such as a pointing device (mouse) and keyboard, a repeater display, and an external module housing.

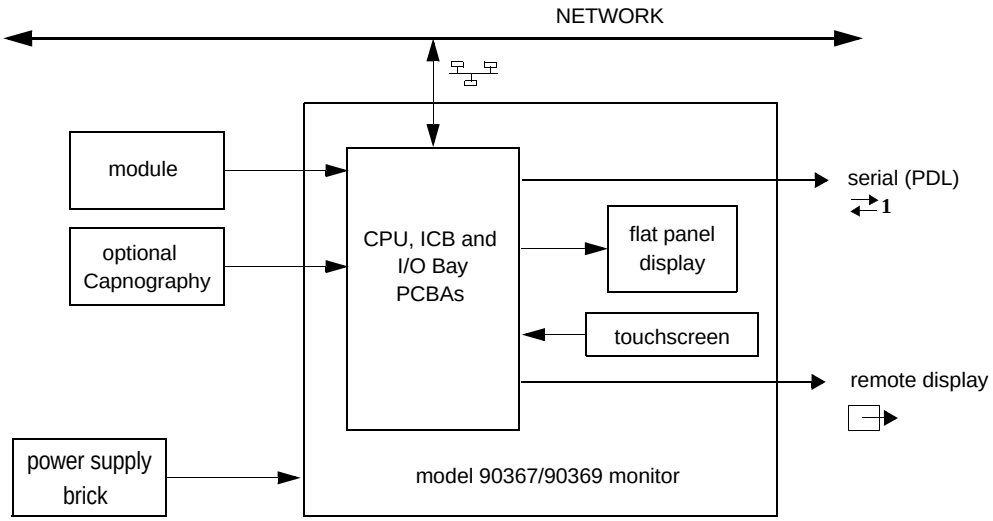


Figure 3-1: Typical 90367/90369 system setup

DC Power Supply

The power supply is a self-contained device that converts AC power to +18 V for use by the monitor. The monitor converts the +18 V into several other voltages internally. The power supply, if it fails, is usually replaced as a single unit (P/N 119-0251-01).

Specifications:

Input: 120 VAC, 60 Hz, 2 A

Output: 18 VDC, 4.25 A

Parameter Module

Any one of the many Spacelabs Medical parameter modules can be plugged into the module port on the Ultraview 90367/90369 Monitor.

The module receives +5 VDC, +12 VDC, and -12 VDC power from the monitor and communicates with the monitor via an SDLC data bus. In the most general terms, the module initially downloads a program (“table code”) into the monitor over the SDLC bus. This enables the monitor to interpret messages from/to the module. The module sends events and data to the monitor, which typically cause the monitor to display waveforms, softkeys, etc. The monitor also responds to key presses of the softkeys, which causes various actions to occur such as changing the way data is displayed.

For more information on the SDLC data bus, refer to the CPU PCBA section.

The theory of operation of a particular module can be found in that module’s Service Manual.

Optional Capnography

The Capnography option is similar in design to other Spacelabs Medical modules, except it is packaged as an extension of the I/O Bay Housing on the back of the monitor. It communicates to the monitor in the same manner as other modules described above.

90367/90369 Monitor

Figure 3-2 displays the major internal components of the monitor and the basic interconnection scheme between the PCBAs. A description of the major components follows.

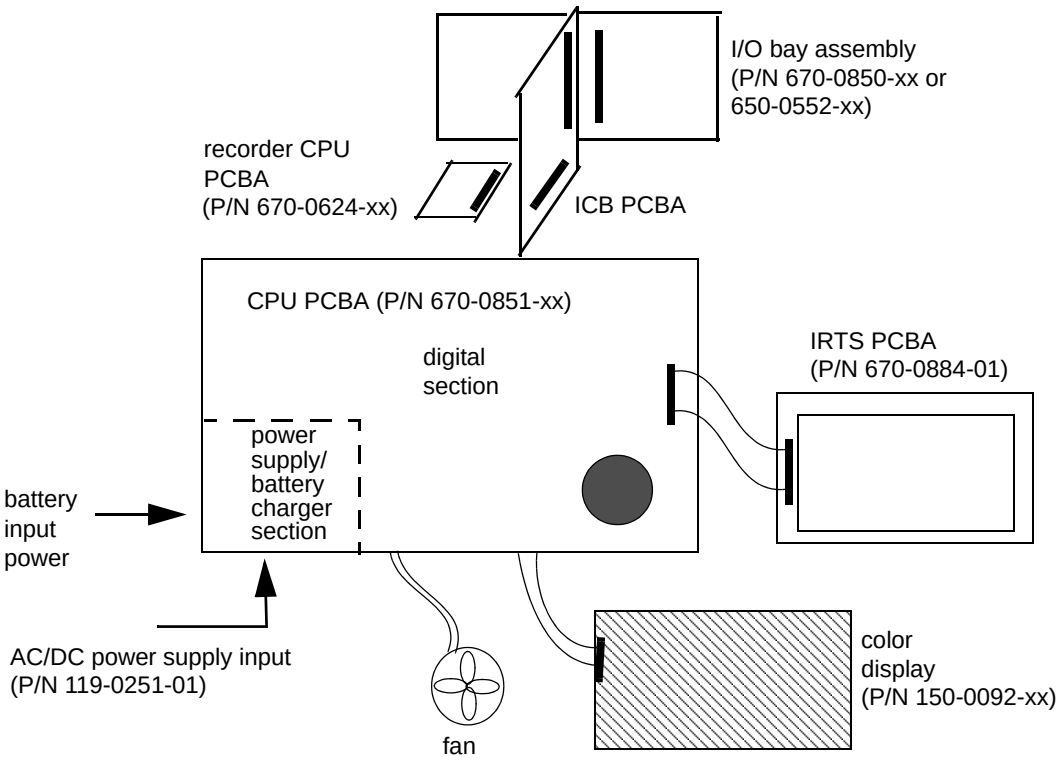


Figure 3-2: Major internal 1030/1050 monitor components

CPU PCBA

The CPU PCBA consists of a CPU subsystem that runs the system software, updates the display, and communicates with peripheral devices through the I/O bay PCBA. The CPU PCBA contains all the major digital components and all the major analog components.

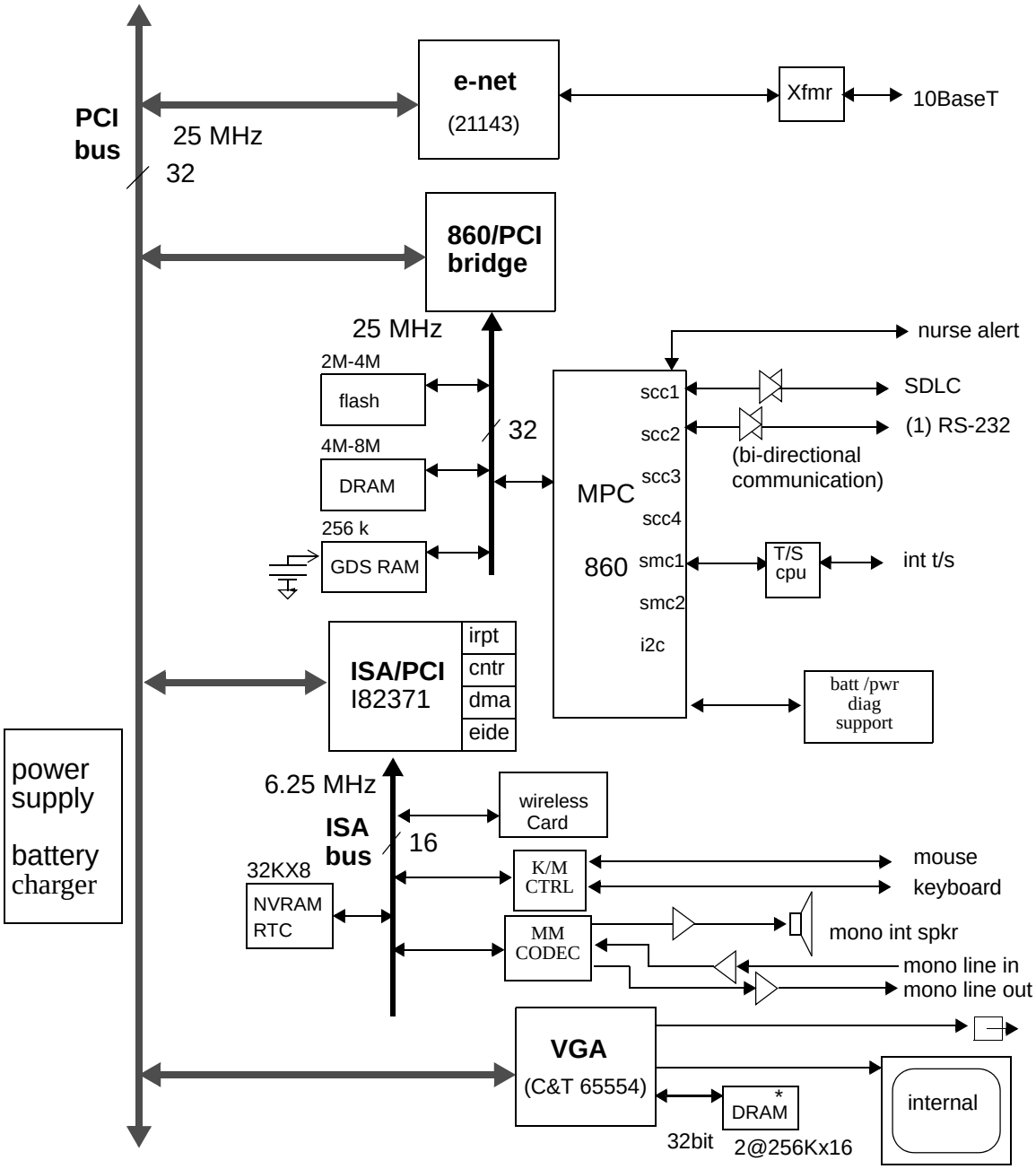


Figure 3-3: CPU PCBA block diagram

Main CPU

The Ultraview 1030/1050 uses a 25 MHz version of the Motorola MPC860 processor. The following are some of the special 860 features:

- PowerPC core processor unit
- 4 KB instruction cache
- 4 KB data cache
- Memory management unit
- Watchdog and event timers
- Interrupt controller
- Programmable chip selects and a DRAM controller for memory and peripheral support
- Six high-speed dedicated serial peripheral ports
- 64 programmable I/O ports

Memory

Flash, DRAM, and SRAM memory are all on the local 860 bus. NVRAM is on the ISA bus.

Flash Memory — Two banks of flash memory are connected to programmable chip selects 0 and 1. Flash memory is used for code storage and is fast enough so that code can be directly executed out of flash. This memory may be in-circuit programmed. The PCBA can hold 2 to 4 MB, with 4 being typical.

DRAM Memory — Two banks of DRAM are connected to chip selects 2 and 3. All DRAM is 3.3 V EDO. From 4 to 8 MB of DRAM can be installed, with 8 being typical. The application program is copied from flash to DRAM upon boot up and is executed from DRAM.

SRAM (GDS) Memory — 256 KB of DRAM are connected to chip select 6. This SRAM holds the GDS data. It is held up through power interruptions by a super cap typically for 12 minutes.

NVRAM Memory — NVRAM is discussed in the ISA section.

MPC860-PCI Bridge

This is a Spacelabs Medical designed Field Programmable Gate Array (FPGA), which implements a bus bridge between the MPC860 processor and the PCI bus. The 860 accesses all PCI and ISA devices through this PCI bridge.

The main functions provided by the MPC860-PCI Bridge are:

- Enables the 860 processor to access Memory, I/O, and Configuration address spaces on the PCI.
- Allows PCI peripherals to access DRAM and SRAM memory installed on the 860 processor bus.
- Converts big endian to little endian and vice versa. The PCI bus is little endian; the 860 bus is big endian.
- Performs PCI bus central arbiter function.
- Performs 860 processor bus arbitration.

Video

The Ultraview video is implemented using a Chips and Technologies 65554 VGA controller that resides on the PCI bus. The video system uses 1 MB of EDO DRAM for video memory, and has analog buffers for the repeater output.

The video controller directly generates digital video signals for the flat panel display. It also generates equivalent analog RGB signals, which are buffered and sent to the external VGA connector for connection to a repeater display. Hsync and Vsync signals also go to the VGA connector.

The 1 MB of DRAM display memory organized as 256 K × 32 - two 256 K × 16 devices. This provides a wide 32-bit path from the controller to display memory.

Communication between the 7555 and a remote display is possible over a DDC2B channel. This allows information, such as resolution, to be passed from the remote display to the 65554.

The CPU PCBA also includes a high voltage power inverter to drive the fluorescent backlight tubes in the display. This circuit is a free running oscillator that generates about 1000 VAC. Although it is a low power circuit, it can cause an unpleasant minor burn if touched. It is surrounded by warning markings on the PCBA. The backlight can be turned ON or OFF by the CPU via a signal from the video controller, and it can be dimmed (run at lower voltage) by the CPU via a signal from one of the latches on the ISA bus.

The power to the flat panel is routed through a FET, which is switched via a signal from the video controller. This is so that the controller can properly sequence the activation of the logic signals relative to power during power ON.

Ethernet

A Digital 21143 PCI based Ethernet controller provides the network interface. It is capable of both 10 and 100 MB Ethernet, however only 10 MB is used at this time. This chip directly attaches to the PCI bus and uses a transformer/filter and several passive components to attach to 10BaseT ethernet.

PMC Connector

One set of PCI Mezzanine Card (PMC) connectors are provided on the PCBA. These are intended to allow PCI debugging devices in the form of a standard PMC card to plug directly onto the CPU PCBA.

ISA Bridge

The ISA bridge connects the PCI bus to an ISA bus and the components on the ISA bus. The bridge chip (Intel 82371) also contains several useful support functions:

- Seven DMA channels usable by peripherals on the ISA bus
- Three counter/timers
- Three chip selects
- IDE controller

The bridge and ISA bus components are collectively referred to as the ISA subsystem. This subsystem is used for less performance critical peripherals, specifically, audio, wireless LAN, NVRAM, real-time clock, keyboard, mouse, and I/O buffers.

Audio

The Audio subsystem is based on a Crystal CS 4231A Multimedia Codec. This chip is capable of supporting simultaneous stereo in and out, however the device is used only in monophonic mode in a 1030/1050 monitor. An audio amp is used for the internal speaker, and op-amp buffers are used to drive the line out connector.

For diagnostics, the line out and the speaker signals can be fed back into the line in pins to verify that the audio outputs are operating correctly. This is controlled by writing to a register in the codec (this feature has not yet been implemented).

Wireless LAN Card

The wireless LAN is implemented using the Proxim Inc. RangeLAN2/OEM card. This device mounts on the CPU PCBA and connects to the ISA bus via a flex cable. A chip-select signal is generated from the ISA addresses by the ISA EPLD and is used to select the wireless LAN card. An interrupt is also provided from the wireless card to the MPC860 CPU to inform the CPU that the card has data. All timing is essentially ISA standard. The wireless card resides in ISA I/O space. All data transfer is performed via software programmed I/O — the wireless LAN card does not support DMA (direct memory access). All communications to and from the card are in the form of packets. These packets contain received data or data for transmission or commands to the wireless LAN card.

Non-Volatile RAM/Real-time Clock

The NVRAM and real-time clock (NVRAM RTC, refer to *Figure 3-3*) reside on the ISA bus. Both functions are implemented with a Dallas Semiconductor DS1644 Non-volatile Timekeeping RAM. The NVRAM chip contains the following functions:

- A 32K × 8 Static RAM.
- A time-of-day clock, which overlays the uppermost 8 RAM addresses.
- An integrated lithium battery with a 10 to 20 year lifetime.
- An integrated clock crystal with ±1 minute/month accuracy.
- Power-fail circuitry to protect the clock and RAM on power down.

The NVRAM is used to hold sysgen values, error logs, and other miscellaneous system data. The real-time clock keeps track of time while the unit is ON or OFF. An enable bit in the ISA bridge chip must be set to enable writing to the NVRAM. The device is socket mounted for easy replacement.

Keyboard/Mouse Interface

The keyboard and mouse interface (K/M CTRL, refer to *Figure 3-3*) is implemented with the Intel 82C42PE programmable interface chip. This device resides on the ISA bus. This device comes pre-programmed with a Phoenix keyboard/PS-2 mouse BIOS.

ISA I/O Buffers

These latches and buffers interface miscellaneous low-frequency status and control signals to the ISA bus.

SDLC Interface

The SDLC bus is the communications interface to Spacelabs Medical modules, which supply patient data to the system. This interface is routed and connected in several ways in the monitor. It is routed internally through the ICB PCBA to the internal plug-in module slot in the monitor. It is also routed through the ICB and I/O Bay PCBAs for communication with the optional Capnography pack and to an optional external module housing via the SDLC connector.

The SDLC interface runs at a 1.892352 MHz frequency. This is divided down to generate a 448 Hz sampling rate. The SDLC communication task has a built-in program, which retrieves the data from the bus, assembles it into a packet format, and provides it to the CPU.

The SDLC clock signals are output by the SDLC interface and are used to drive the external SDLC bus and modules. The SDLC data signals are bi-directional and can be used both to transmit and receive data from the intelligent modules.

Touchscreen Circuitry

The touchscreen circuitry is composed of a micro controller with internal memory and an internal analog-to-digital converter, a separate digital-to-analog converter, and some discrete components. Via the D/A and other signals, the micro controller drives the IR emitters on the touchscreen PCBA. Using its internal A/D, it scans the detectors on the touchscreen PCBA looking for beam breaks. When it detects a break, it sends a message via a serial data bus to the MPC860 CPU, informing it of which beams are broken. The MPC860 CPU translates this into screen coordinates and responds to key presses appropriately.

The touchscreen controller can run a calibration of the touchscreen. It drives an emitter and monitors the detector, noting how strongly the detector responds. It repeats this for each emitter-detector pair and maintains a table of the characteristics of each pair. It uses this data during normal operation to drive each pair. Calibration enables it to compensate for differences in device characteristics, device alignment, bezel transparency, and ambient lighting.

Nurse Alarm Output

When an alarm sounds, a relay on the PCBA is activated. This is connected to the nurse alarm connector . When this connector is connected to an external nurse alarm light/buzzer, the light/buzzer will activate when an alarm occurs.

Note:

If TONE RESET is activated, the external alarm will continue. If ALARM SUSPEND is activated, the external alarm ends.

Clock Distribution

The clock distribution system is designed to provide low skew clocks to the core hardware operating off of the MPC860 and PCI busses. Additional lower tolerance clocks are needed in other peripheral areas.

A Motorola PLL-based clock driver chip is used to provide a low skew clock distribution system and provide several optional operational configurations. This provides clocks to all of the PCI devices with under 1.0 ns of skew, including wiring delay variation. The MPC860 and FPGA clock skew falls within this specification also. The device can be pin-strapped programmed for various clock frequencies including 25, 33, and/or 50 MHz. Currently both the 860 and PCI devices run at 25 MHz.

These clocks are used for specific peripherals and are generated at various locations on the PCBA.

- 20 MHz clock for Ethernet
- 24.6 MHz clock for audio codec
- 16.9 MHz clock for audio codec
- 12 MHz clock for keyboard/mouse controller
- 14.3 MHz clock for the PCI/ISA bridge and SVGA hardware
- 11.354 MHz divided to 1.89 MHz for SDLC
- 8.33 MHz for the PCI/ISA bridge and ISA bus

Hardware Reset

The hardware reset originates from the MAX695 power supervisor IC. The supervisor IC keeps the 860 PORESET input asserted (thus keeping the CPU from running) when the system voltage is less than 4.65 V. 200 ms after the system voltage exceeds 4.65 V, the supervisor IC releases the 860 PORESET input, allowing the CPU to boot. The 860 generates two reset outputs, HRESET, and SRESET. HRESET is buffered and is used to reset all PCI devices and most other major devices on the PCBA, including ISA devices. ISA devices, however, can also be individually reset under software control by writing to one of the ISA latches.

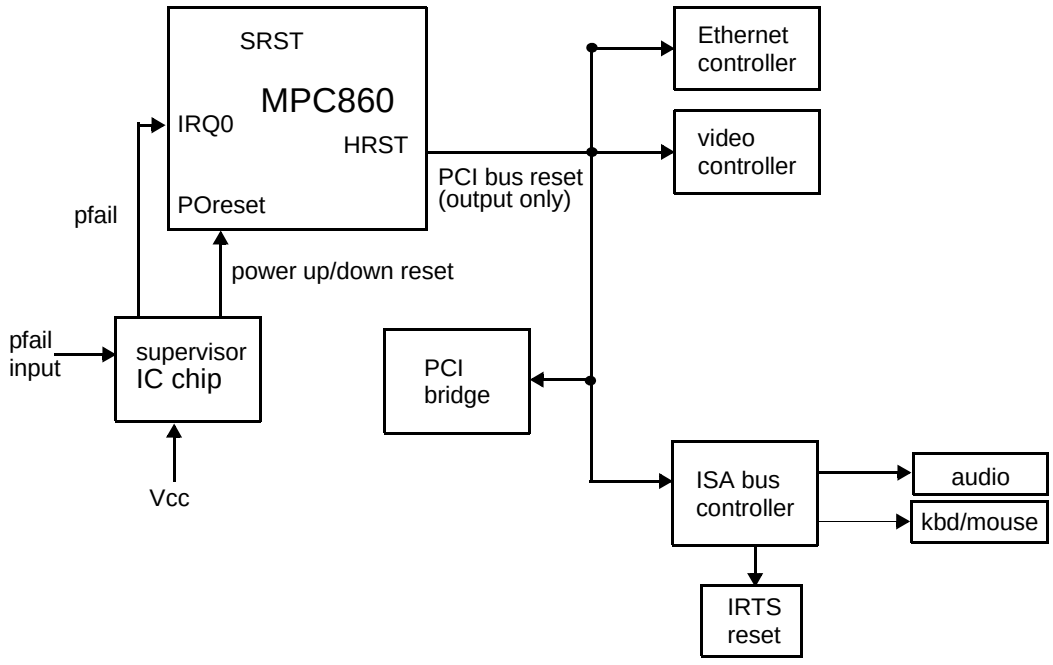


Figure 3-4: Reset signals

Software Reset

To cause a software reset, the 860 causes a unrecoverable situation by first disabling its internal machine check interrupt and then forcing a “machine check” by accessing unmapped address space. This causes the CPU to reboot.

Power Failure Operation

The power supply on the CPU PCBA provides a digital signal PFAIL to the CPU to indicate that a power failure condition is imminent. This signal is asserted by the power supply if its input power fails, or if the monitor is switched OFF. This signal is provided through a power supervisor IC to the MPC860 as an interrupt, causing the processor to take immediate power failure action.

The power supply will continue to provide DC power to the CPU PCBA for a minimum of 1 millisecond after the power failure condition is detected. The host processor must complete all power failure actions during this time.

Hard Reset Configuration Word

At the rising edge of HRESET the 860 reads the data bus bits 15-0 to determine its basic post-reset configuration. Resistor pull-ups on the bus pull certain bits high; the others are pulled low by weak internal pull downs. The 860 is set to read the following:

Bits 15 - 0 = 0000 0110 1000 0010

If any of these bits are stuck in the wrong state at reset, the 860 won’t properly boot. The detailed meaning of each bit is explained in the *860 User’s Manual*.

Interrupts

The MPC860 processor has two on-chip interrupt controllers, one in the System Interface Unit (SIU) and a second controller within the Channel Processor Module (CPM). These handle interrupts on specific input pins of the MPC860. Some interrupts are also routed through the interrupt controller in the ISA bridge.

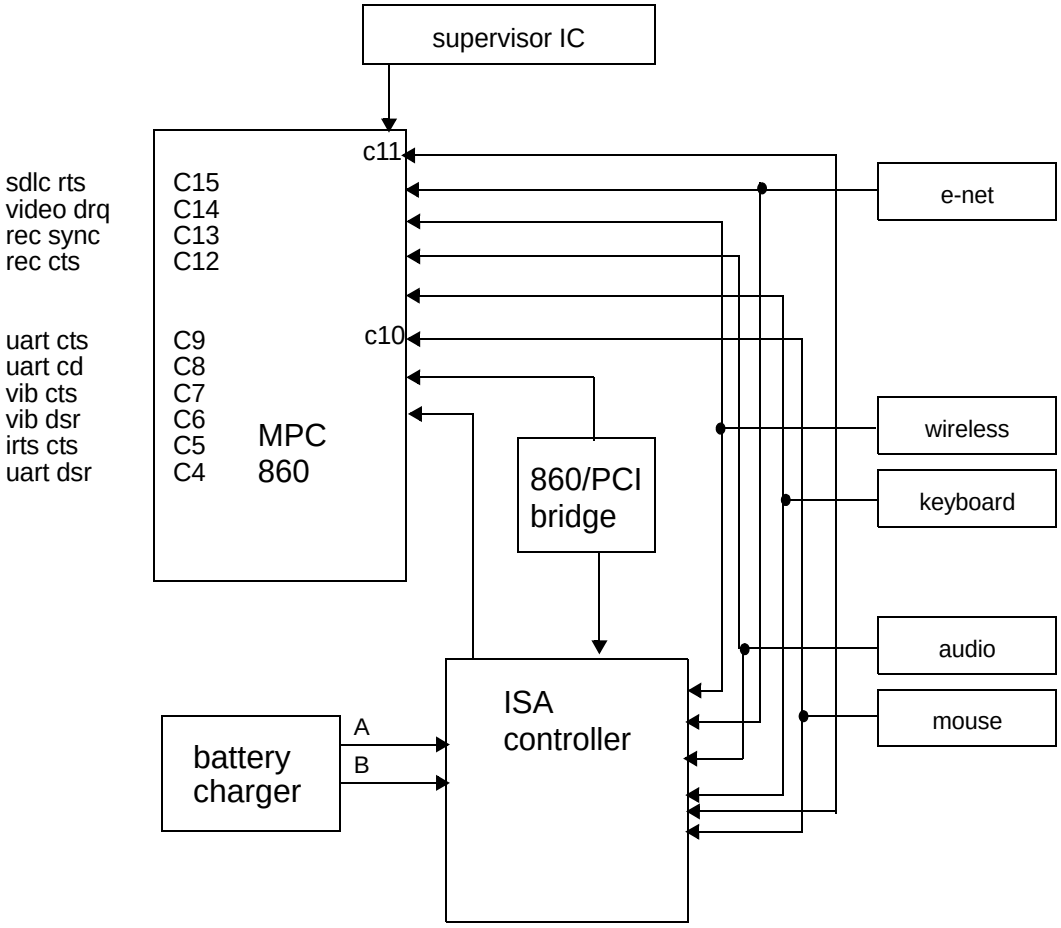


Figure 3-5: Interrupt block diagram

Power Supply System

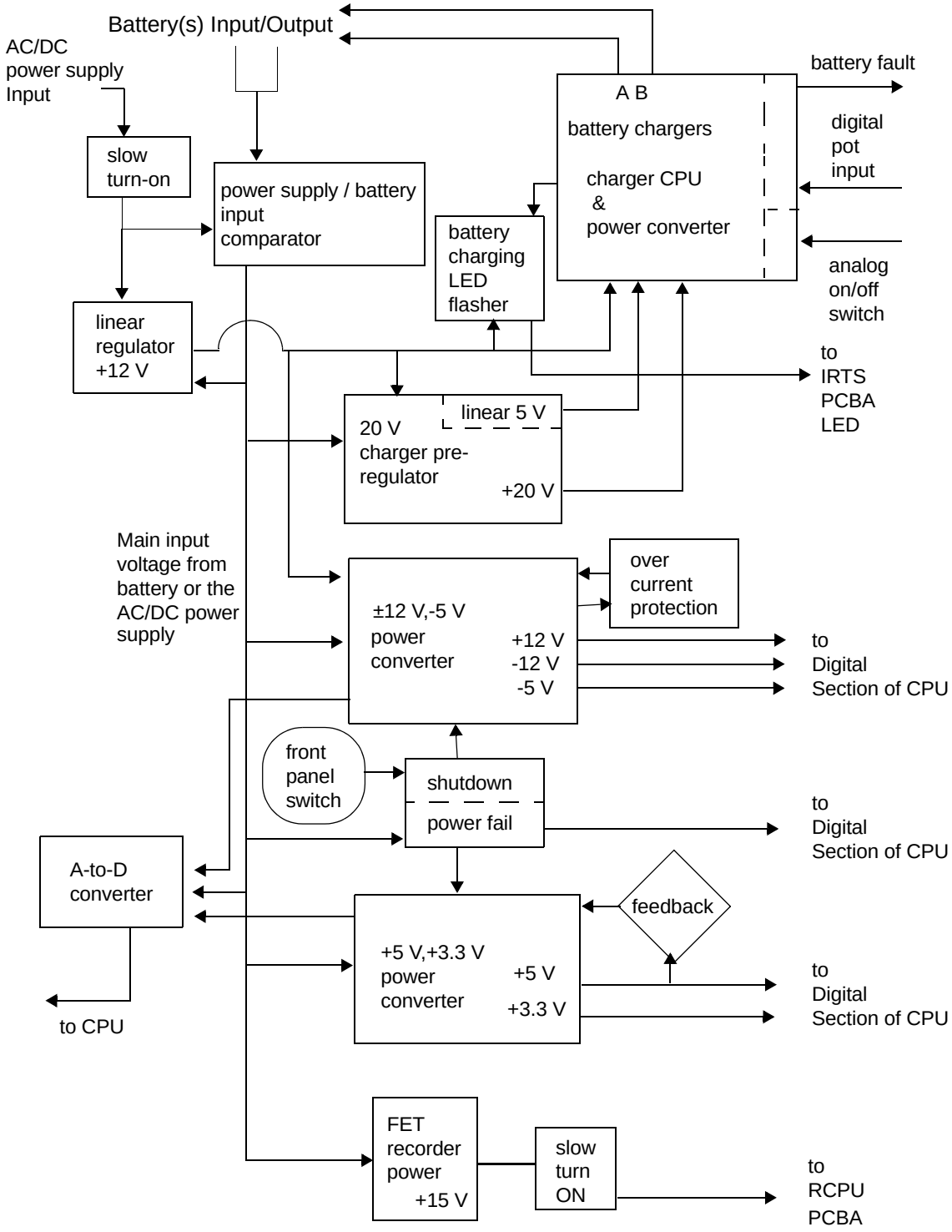


Figure 3-6: Power supply block diagram

The power supply has these features:

- 7 output DC voltages (+5 V, +3.3 V, +12 V, -12 V, -5 V, +20 V, +15 V)
- Automatic battery switch over operation
- Self shut-OFF when on battery operation and battery voltage is low
- Over current protection
- Wide input voltage range, <12 V to 24 V
- >46 W output capability

Slow Turn-On — The slow turn-ON circuit is needed to reduce the possibility of arcing when the cable from the AC/DC power supply is plugged into the PCBA.

Battery Input Comparator — The minimum start up and operating voltage provided by the AC/DC power supply is 11.5 VDC. If the battery voltage is above the input voltage and the input voltage from the AC/DC power supply is below 12 V, the system will operate from the battery power via a comparator which switches between using an AC/DC power supply or the batteries for power.

Linear Regulator — The +12 V linear regulator is needed to operate the charger pre-regulator circuit and also to provide “house keeping power.” This +12 V is the only source of power to operate the +20 V pre-regulator IC chip. Without this +12 V linear regulator power, the +20 V pre-regulator circuit and, therefore, the battery charger does not operate. This is why the battery charger works from the AC/DC power supply power but not from the batteries.

±12 V, -5 V Power Converter — This is a single-ended flyback converter topology based on a circuit designed around the MICREL 38HC43 pulse width modulation (PWM) controller. It operates at 100 KHz. The circuit is regulator based on feedback from the +12 V output. The - 12 V and the -5 V outputs are unregulated and consist of only the transformer output, a diode rectifier, and a capacitor.

The output power rating for the +12 V (±0.3 V) section is 24 W. The power rating for the -12 V (±1.21 V) is 1.2 W. The power rating for the -5 V (±0.9 V) is 0.5 W.

Varying power input requirements, such as DC from an ambulance, Spacelabs Medical power supplies (+24 VDC and +18 VDC), and battery voltage (10.6 VDC to 13.5 VDC), require the converter to be functional from 10.6 VDC to 24 VDC input.

+5 V, +3.3 V Power Converter — This is a step down DC-to-DC converter (also called a “buck” converter) dual output power system. The design is based on MAX796 PWM (pulse width modulation) controller. The frequency if fixed at 150 KHz. The circuit is regulated via a combination of 3.3 V voltage feedback and +5 V current feedback.

The +5 VDC is capable of 15 W continuous. The +3.3 V is capable of 6 W continuous. The circuit has a wide input voltage requirement and capability as does the ±12 V/-5 V converter.

This converter provides power at better than 80% efficiency.

Battery Chargers

The battery chargers have the following features:

- Front panel LED battery charging/failure indicator.
- Automatic “battery care” recharge cycles to ensure a maximum charge.
- One or two batteries fully charge in 90 minutes if the system is not operating; 4 to 5 hours while unit is operating.
- Individual battery chargers for each of the 2 batteries so that a bad battery will not degrade the other battery. Will not prematurely “kill” batteries.

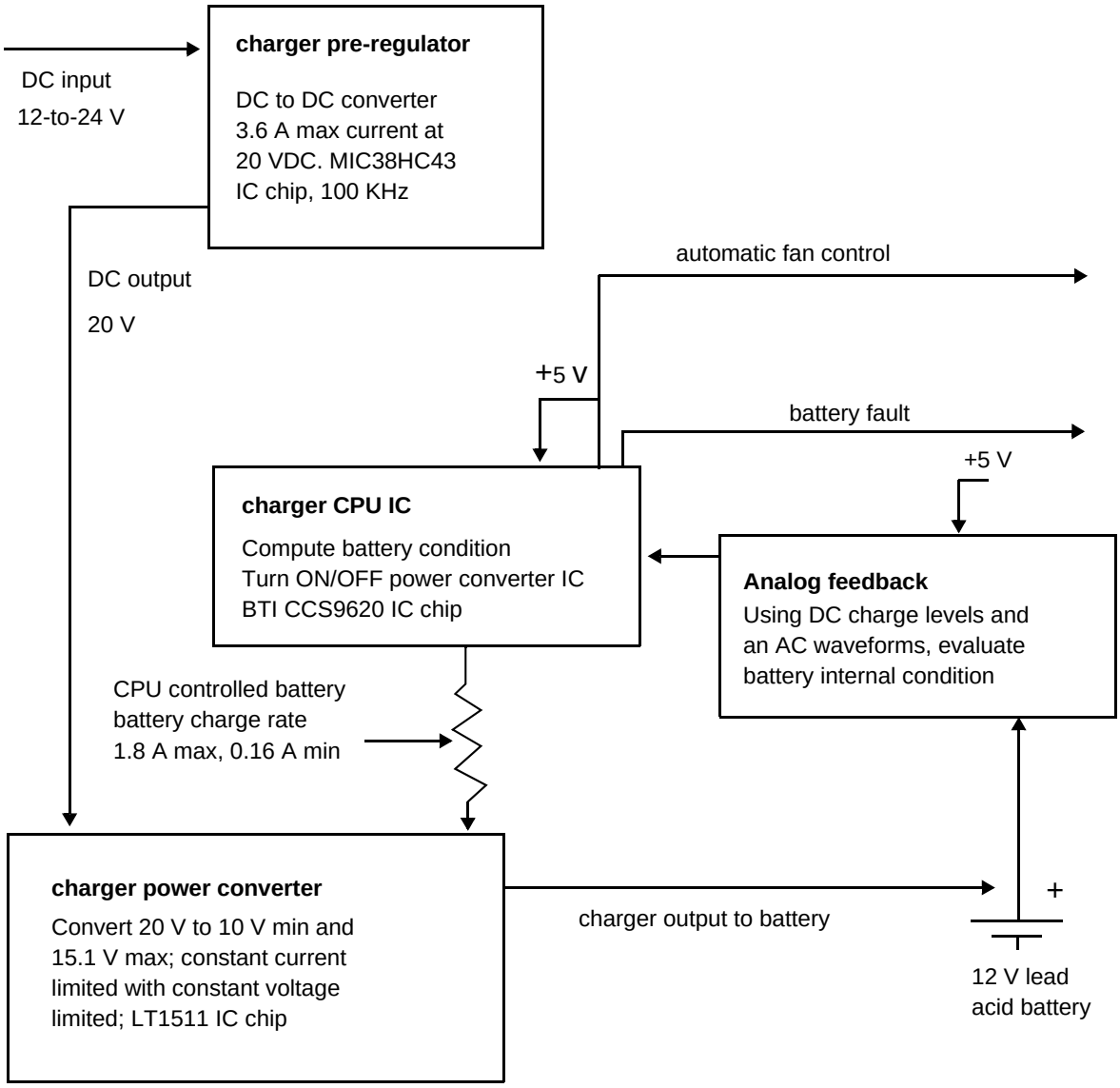


Figure 3-7: Charging circuit block diagram

Note:

The 90367/90369 system contains two identical battery charging systems, one for each battery.

Charger Pre-Regulator — The +20 VDC output provides up to 60 W of battery charging power. This DC output voltage is then used as the main power source for charging batteries. The circuit uses a single-ended flyback converter topology. This pre-regulator circuit is active at all times when the 90367/90369 is powered from the external power supply voltage.

Charger CPU IC — This IC is a pre-programmed microprocessor designed specifically for controlling the charging of batteries. The CPU monitors the voltage and resistance of the batteries while charging and determines when to turn the charger power converter ON or OFF. It also can detect faulty batteries. The CPU also periodically performs maintenance cycles to keep batteries fully charged.

Charger Power Converter — The power converter consists of a LT1511 step down converter and various discrete components. It is turned ON and OFF under the control of the charger CPU IC. When ON, it charges the batteries with a maximum current that is allowed by the charge rate control circuit.

Charge Rate Control — The minimum battery charge rate is always controlled by the battery itself. A battery will only accept the current it is capable of converting to charge inside the cells. However, the control for the maximum battery charge current is controlled in one of two ways. If the 90367/90369 unit is powered from the power supply and the front panel switch is OFF, the maximum charge current defaults to the maximum current that the batteries can take, which is 1.8 A. If the 90367/90369 unit is powered from the AC/DC power supply and the front panel switch is ON, the CPU will have control of the maximum battery charge rate via an analog switch and digital potientometer. The CPU monitors the power consumed by the monitor electronics and adjusts the charge current based on the amount of remaining power available from the power supply.

Battery Charging LED Flasher — This is a simple op-amp oscillator circuit that controls the behavior of the front panel LED. When the batteries are charging, a signal from the battery charging circuits causes the oscillator to run, which causes the front panel LED to flash. When the AC/DC power supply is present and the batteries are not charging, the front panel LED is forced continuously ON. The front panel LED is OFF when the unit is not powered from the AC power supply. The front panel switch has no control over the front panel LED.

Battery Fault/Interrupt Signal — If the battery voltage exceeds the upper limit, the charger CPU IC will power OFF the charger and then attempt to charge again. If the battery voltage exceeds the upper limit again, a 1 Hz signal will be sent to an MPC860 CPU interrupt input (via the ISA bridge). The software will sense this 1 Hz rate and will indicate a battery failure. If the battery voltage is too low, the process is the same.

Automatic Fan Control — The MPC860 CPU monitors internal temperature via temperature sensors and an A/D. If the temperature exceeds a preset limit, the CPU will run the fan at a normal speed until the temperature is reduced. However, during battery charging, the battery chargers override the CPU and force the fan on at a higher than normal speed. This allows the battery chargers to run at full output without overheating the unit.

Note:

Fan will not operate unless a battery is plugged in.

EMI Reduction

The CPU PCBA includes several design features intended to reduce EMI effects. The power supply connections throughout the PCBA are segmented and heavily filtered to prevent noise propagation from one part of the PCBA to another. All high frequency signals are driven through series resistors to limit the rise and fall times of these signals, reducing ringing and other EMI effects. The construction of the multi-layer PCBA is such that noisy signals are shielded by power and ground planes.

Boot Sequence Overview

When power is applied, the unit begins its boot up sequence. The following is a highly abbreviated version of the sequence of events that occurs while the unit is booting.

1. Program execution starts at address 7F000100 in Flash.
2. Key internal and external devices and memories are mapped and enabled.
3. The boot-type value is read from super-cap-backed SRAM. This value is written to SRAM at every power down or self-reboot. The value determines the kind of boot, warm or cold. Warm booting skips diagnostics and other steps in order to boot as quickly as possible.
4. Key areas of DRAM are tested (cold boot only).
5. The boot code is copied from Flash to DRAM and program execution resumes in DRAM.
6. More internal and external devices are initialized.
7. Other key memory and CPU tests are performed (cold boot only).
8. The VxWorks kernel is started.
9. Drivers needed for diagnostics and the boot console are installed.
10. Diagnostics are run (cold boot only).
11. Boot logo and the 3-2-1 countdown are displayed (cold boot only).
12. The application code is copied from Flash to DRAM and executed in DRAM.
13. Much of the above initialization is repeated, less all testing, this time as part of the application code.
14. Normal monitor operation begins.

Normal Operation Overview

This is a very high-level summary of what the software does as part of its normal operation.

Once the unit is booted it begins normal monitor operation. Normal operation can be viewed as several high-level Ultraview Care Network software subsystem tasks running simultaneously. These interface to other tasks, and all the tasks interface to hardware devices via software called device drivers.

MAIN Ultraview Care Network SUBSYSTEMS and TASKS:

The SDLC subsystem sends packets from the modules to the rest of the system, including Ethernet and GDS, and it also sends packets to modules.

The Interpreter subsystem provides modules and Keys with “primitives” that they use, via table code, to create and control their human interface on the monitor.

The keys subsystem handles touchscreen key presses. It receives key presses from the user and notifies the keyboard interpreter that then runs the appropriate table code program. That program uses the key display task to redraw the new key state as feedback to the user.

The global data system (GDS) is the patient database with parameter data from the modules. It contains current, general, trend, and waveform data.

The remote interface system handles Ethernet connections to remote monitors and modules. It broadcasts the existence and configuration of network devices to each other, allows remote parameter attaches and remote key press connections across the network, downloads the module table code to remote monitors to create the same human interface on multiple monitors, supports the Alarm Watch and Remote View functions, and handles multicast waveform data.

The Recorder subsystem controls local recorders and network recorders.

The Alarm subsystem handles the standard Ultraview Care Network alarms. Modules send alarm conditions over SLDC, and in response the alarm subsystem sends alarm messages to the tone, display, record, and network tasks. It receives messages from the network for Alarm Watch alarms and from SDLC tasks for module/channel adds or deletes.

Minor system tasks, and device drivers

The Ultraview Care Network subsystems above communicate display information to the Display Manager (DM) task. The DM receives display changes from these subsystems and issues the appropriate graphics draw primitives to update the display. The graphics primitives actually update the display through the video device driver.

The Ultraview Care Network subsystems interface to SDLC via Rx/Tx buffers in memory, driven by a 32 Hz interrupt.

The Ethernet interface uses dynamic memory for receive and transmit. One Ethernet interrupt occurs for both receive packets and command completes. An Ethernet write command is used for transmitting packets. An “Ethernet-user” task maintains and uses a routing lookup table to switch network packets to the appropriate network driver — the ethernet device driver or the wireless network card device driver.

The Ultraview Care Network recorder function uses these SDLC/Ethernet drivers directly.

The touchscreen driver, the external keyboard, and mouse drivers provide x-y coordinates to the keyboard task for activating the on-screen keys.

The tone task is responsible for timing and prioritizing tones from the Alarm subsystem, the Keys subsystem, and other system tasks. It receives commands to turn ON and OFF, to suspend, and to change volume. It also looks up wavetable tones and sends them to the Mixer task. The Mixer task mixes the alarm sounds with information tones as needed. These task talk to the audio hardware via the audio device driver.

Touchscreen PCBA

The touchscreen PCBA consists of an array of infrared emitters and detectors that surround the flat panel screen and generate an array of horizontal and vertical infrared beams over the surface of the screen. Electronics on the CPU PCBA drive and scan the beams to detect key presses. Refer to the *<i Italic>Touchscreen Circuitry on page 3-8* for more information on touchscreen operation.

The touchscreen PCBA also contains the front panel power switch and a diagnostics LED.

Touchscreen connections

The touchscreen PCBA connector accepts a 26-pin flat, ribbon cable from the CPU PCBA.

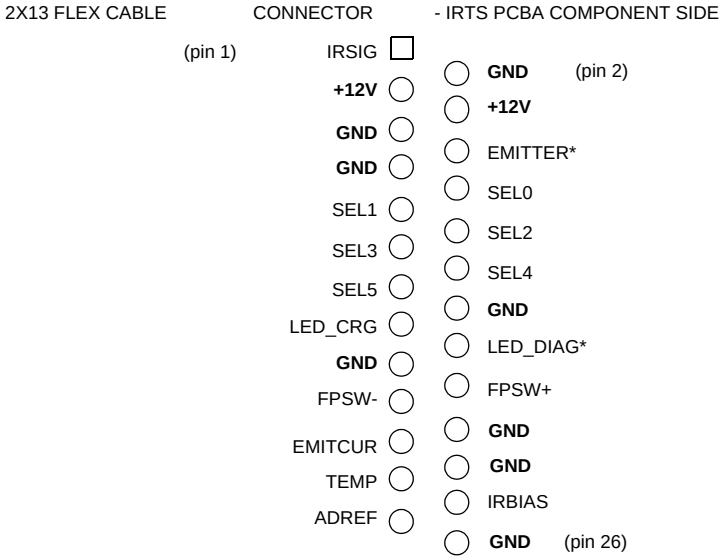
Table 1: Touchscreen PCBA Connector Pinout

1	IRSIG	Output	detect/no detect IR beam
3	+12 V	Input	
5	gnd	Input	
7	gnd	Input	
9	SELECT1	Input	
11	SELECT3	Input	
13	SELECT5	Input	
15	LED_CHARGE	Input	Charge status LED (high turns on LED, current limited by main PCBA LM339 output pull up)

Table 1: Touchscreen PCBA Connector Pinout

17	gnd	Input	
19	FPSW-	Output	
21	EMITCUR	Input	Drive voltage to IR LEDs
23	TEMP	Output	Temperature sensor
25	ADREF	Output	Analog VCC reference

TOUCHSCREEN CABLE PINOUT



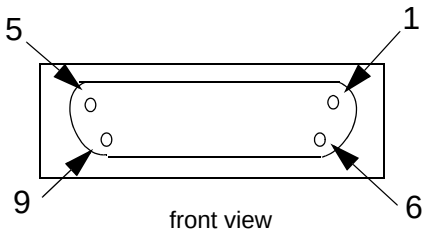
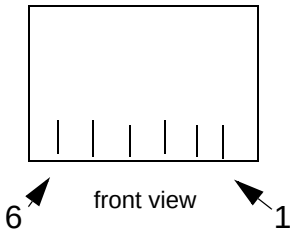
I/O Bay PCBA

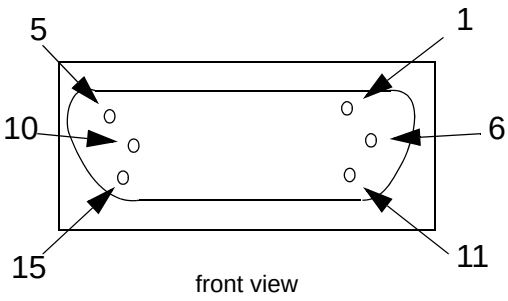
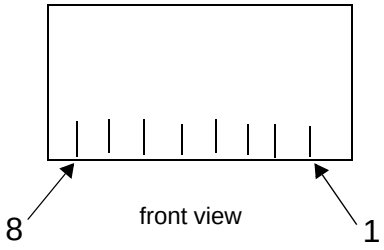
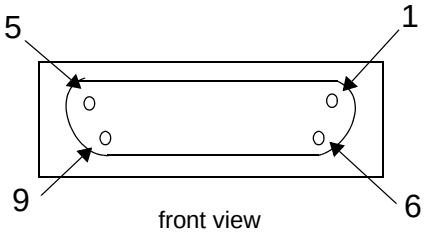
General

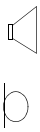
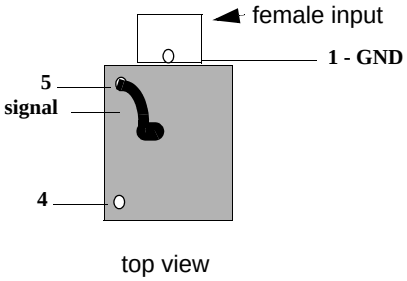
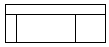
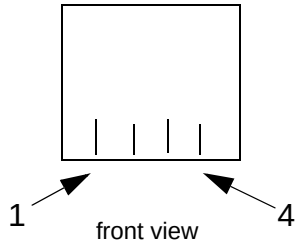
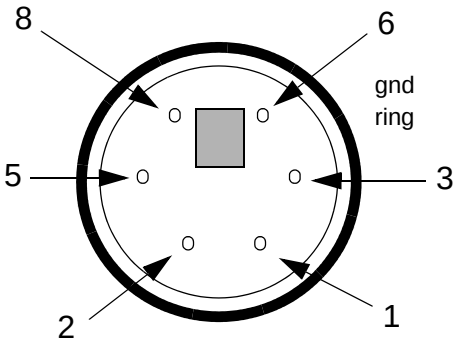
The basic I/O bay PCBA connects the rear external connectors to the CPU PCBA via the interconnect PCBA.There are no active components on this PCBA, rather, all the components are connectors, ferrite beads, capacitors, and resistors.

With the Capnography option, the I/O bay PCBA is split into two pieces and mounted inside an extended I/O bay housing that also holds the capnography electronics.

External Connectors

Component	Description	
Serial port connector	DB 9-style, female 1- CD 2- TX (should be RX) 3- RX (should be TX) 4- DTR 5- GND 6- DSR 7- RTS 8- CTS 9- N/C	
alarm connector	RJ-11-style, 6 pin 1- ALARM, COMMON 2- N/C 3- ALARM, NORM. OPEN 4- +12 V 5- N/C 6- GND	

Component	Description	
remote display connector	DB 9-style, 15 pin, female 1- ANALOG RED 2- ANALOG GREEN 3- ANALOG BLUE 4- N/C 5- N/C 6- GND (RED) 7- GND (GREEN) 8- GND (BLUE) 9- N/C 10- N/C 11- N/C 12- DDC2B DATA 13- HSYNC 14- VSYNC 15- DDC2B CLOCK	
Ethernet connector	10BaseT, RJ-45 style 1- TX+ 2- TX- 3- RX+ 4- N/C 5- N/C 6- RX- 7- N/C 8- N/C	
external SDLC connector	DB 9-style 1- GND 2- DATA+ 3- DATA- 4- +5 V 5- +12 V 6- CLK+ 7- CLK- 8- -12 V 9- GND	

Component	Description	
audio connector 	3.5 mm size, mono, female IN 1- GND 4- GND 5- Left OUT 1- GND 4- NC 5- Signal Signal input is grounded when no plug is inserted	 top view
keyboard connector 	RJ-9-style, 4 pin 1- GND 2- CLK 3- +5 V 4- DATA	 front view
mouse connector	DIN-style, 6 pin 1- DATA 2- N/C 3- GND 5- +5 V 6- CLK 8- N/C gnd ring-	 top view
ferrite bead	100 MHz @ 200 mA	

Recorder Interface PCBA

The Ultraview 1030/1050 system's internal recorder is supported by a separate CPU PCBA that connects to the Ultraview 1030/1050 main processor. Electrical signals are routed through the interconnect PCBA from the CPU PCBA connector.

ICB (Interconnect PCBA)

The interconnect PCBA connects the CPU PCBA to various other parts of the monitor. It bridges the CPU PCBA to the I/O bay PCBA, it connects the module to the CPU PCBA, and it connects the recorder and recorder CPU PCBA to the CPU PCBA. The PCBA contains only connectors and passive electronic components.

Display

The flat panel display is a 640 × 480, active matrix, thin-film-transistor color display from Sharp. It receives 18 data signals, 4 timing signals, +5 V, GND, and about 1000 VAC backlight voltage from the CPU PCBA. The clock is approximately 25 MHz, and the vertical refresh rate is about 60 Hz. In the 1030 product, the display is driven with data for only a few colors.

The pinout of the display connector (at the display) is given in *Table 2*. The backlight is connected via a separate 3-pin connector.

Table 2: Display Connector Pinouts

Pin #	Symbol	Description
1	GND	
2	CLK	
3	HSYNC	Horizontal Sync
4	VSYNC	Vertical Sync
5	GND	
6	R0	Red Data LSB
7	R1	
8	R2	
9	R3	
10	R4	
11	R5	Red Data MSB
12	GND	
13	G0	Green Data LSB
14	G1	
15	G2	
16	G3	
17	G4	
18	G5	Green Data MSB
19	GND	
20	B0	Blue Data LSB

Table 2: Display Connector Pinouts (continued)

Pin #	Symbol	Description
21	B1	
22	B2	
23	B3	
24	B4	
25	B5	Blue Data MSB
26	GND	
27	ENAB	Settle the horiz. display position
28	VCC	+5 V
29	VCC	+5 V
30	R/L	Horizontal display mode select
31	U/D	Vertical display mode select

Contents

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Overview

Caution:

Observe precautions for handling electrostatic-sensitive devices!

Note:

- *Never touch electrostatic-sensitive electronic components without following proper anti-static procedures, including the use of an ESD wrist band and mat. An electrostatic discharge from your fingers can permanently damage electronic components.*
- *All static-sensitive electronic components are packaged in static-shielding bags. Retain the bag for repackaging the component, should you need to store it or return it to Spacelabs Medical for any reason.*
- *Cleaning, preventive maintenance, and safety checks should be performed annually and following any product disassembly/assembly. Preventive maintenance and safety checks must be performed by trained personnel only.*

Cleaning/Disinfecting

Warning:

- ***Use only recommended cleaning solutions, or you may void the manufacturer's warranty.***
- ***Harsh chemical agents degrade plastics and will compromise the safety of the device.***
- ***Disconnect the equipment from the patient and the electrical supply before cleaning.***
- ***Do not allow liquid to enter the interior of the module or monitoring equipment.***
- ***Do not immerse the equipment or cables in water or cleaning solutions.***
- ***Do not autoclave.***

To clean the exterior of monitors, modules, and cables:

- Prepare the cleaning solution according to the manufacturer's instructions.
- Wet a clean cloth with the selected cleaning solution.

- Remove excess liquid from the cloth and squeeze dry.
- Wipe exposed surfaces of the equipment and cables.
- Remove any soap residue by gently wiping with a clean damp cloth.
- Wipe dry with a clean dry cloth.

Use only the following recommended cleaning solutions:

- Mild soap and water solution
- U.S. Pharmacopoeia (USP) green soap
- Sodium hypochlorite solution (1:10 dilution of household chlorine bleach in water)
- Phenolic germicidal detergent (1% aqueous solution)
- Glutaraldehyde (2.4%) (Cidex)
- Isopropyl alcohol (70% solution)

Note:

Over time, repeated use of a chlorine bleach solution may cause some colors to fade.

Tape adhesive can be removed with Spacelabs Medical adhesive tape remover pads (P/N 392196-001).

Questions and concerns about cleaning issues should be directed to a Spacelabs Medical field service engineer.

Fan Filter

Check that the fan filter is clean. If required, clean the filter by washing it with mild soap and water.

Monitor, Expansion Housing, Module Housing, and Recorder

Clean the case by washing it with mild soap and water or use Plast-N-Glas cleaner. Use TF solvent for cleaning the electronic connectors and contacts as necessary.

Note:

Avoid directly spraying liquids into the recorder openings.

Capnography Sensors

The capnography sensor and cable should be cleaned routinely, especially between patient uses. Before cleaning, make sure the sensor is disconnected from the module and/or monitor. Sensors and cable assemblies may be wiped down using a cloth or swab dampened in 70% alcohol or 10% bleach solutions. Mild detergents may also be used initially to remove any residual buildup. Sensors should be wiped immediately following cleaning with distilled water and then dried to remove any cleaning residue.

Caution:

- **Under no circumstances should sensors be immersed in a solution of any type.**
- **Do not autoclave the sensor.**
- **Never use solvents, acetone, or abrasive cleaning agents.**
- **Do not force the sensor onto the airway adapter.**
- **Avoid undue stress on the sensor head and the cable.**

Note:

- *After unpacking, keep the sensor container. When not in use, disconnect the sensor from the module and/or monitor, clean, and place it into the container for safe keeping.*
- *Sensor exposure to cleaning agents should be limited to a maximum of 15 to 20 minutes. Longer intervals of exposure could produce a slight dulling of the original surface finish.*

Visually inspect the sensor, cable, and the airway adapters for any sign of physical damage. Verify that the plugs and connectors are in good working condition and that the pins and prongs are not bent. Use a cotton swab dampened with alcohol or a mild soap to carefully clean the windows of the sensor head and the calibration cells. Always remove any damaged or questionable sensor or airway adapter from service.

Mechanical Inspection

Verify that:

- the unit and all optional equipment are clean;
- all screws are tight;
- the case and connector pins are not damaged; and
- there are no frayed or pinched wires or cables.

Electrical Safety Testing

Safety testing protects the patient from electrical shock, especially micro-shock. It has been determined experimentally that current values in the microampere (μA) range may cause fatal arrhythmias in electrically susceptible patients. A patient is deemed electrically susceptible when connected to monitoring equipment.

Definitions

Classification — IEC/EN/UL 60601-1 Safety standard designation for the class of equipment and type of patient applied parts that indicate the degree of protection provided against electrical shock.

Leakage Current — Current that is not functional. It includes patient leakage, ground leakage, and enclosure (or chassis) leakage.

Patient Lead Leakage — Current that flows from the applied part of the patient lead to ground.

Chassis Leakage — Current flowing from the enclosure (or from conductive parts accessible to the operator) through the ground conductor.

Normal Condition — Condition in which all means provided for protection are intact. Includes ground connections, insulation, creepage, and clearance distances.

Single Fault Condition — Open ground, open neutral, line voltage on a patient connection, or any single state other than normal condition that could compromise patient safety.

UUT — Unit Under Test

Spacelabs Medical does not endorse standards to the exclusion of others. **BE SURE TO CHECK YOUR LOCAL REQUIREMENTS TO ENSURE YOUR EQUIPMENT SAFETY TESTS COMPLY WITH LOCAL STANDARDS**. Generally accepted standards for medical monitoring equipment, such as the Underwriters Laboratory (UL) and the National Fire Protection Association (NFPA) standards, are summarized in *Table 1* below.

Table 1: Summary of Standards for Medical Monitoring Equipment

International Mains to Chassis Leakage	US (120 V) Mains to Chassis Leakage	Mains Resistance
100 μA - normal condition, ground attached (AC connector to chassis)	300 μA - normal condition, ground attached (AC connector to chassis)	500 milliohms*
500 μA - single fault condition, open ground or reverse polarity	300 μA - single fault condition, open ground or reverse polarity	500 milliohms*
* *Measured from the AC Power cord third wire ground to the most distant ground attachment.*		

Equipment Required: Electrical Safety Analyzer, Fluke model 232D or equivalent

These tests should be performed according to the hospital's scheduling requirements, at least annually or after repair or modification.

Note:

All tests must be performed according to the safety analyzer's operations manual, and any local requirements.

Warning:

Before starting safety tests, ensure that no patient is connected to the device under test. If safety tests must be performed on equipment currently monitoring a patient, obtain permission to disconnect the cables from the monitor and patient.

Ground Resistance

1. Attach the power cord to the monitor under test. Then measure the resistance from the AC power cord third wire ground to a chassis location, such as the equipotential post on the rear of the monitor.
2. Verify that the resistance is less than 500 milliohms (0.5 ohms).

Chassis Leakage Current Tests

1. Plug the leakage analyzers into mains power.
2. Plug the equipment into the analyzer's AC receptacle.
3. Verify that the leakage current from the chassis to ground is less than the values in *Table 2*.

Table 2: Enclosure Leakage Test Conditions and Limits

Neutral Condition	Ground Condition	Polarity	International Limit	Domestic Limit
Closed neutral	Closed ground	Normal polarity	100 μA	300 μA
Open neutral	Open ground	Normal polarity	500 μA	300 μA
Closed neutral	Open ground	Normal polarity	500 μA	300 μA

Patient Lead Leakage Current Tests (Patient Modules)

Before you can perform the Patient Lead Leakage Current Test, verify that the monitor passes the ground resistance and chassis current leakage tests. It is recommended that the equipment be operating for 30 minutes prior to the test to allow thermal stabilization. If a 12-lead patient cable is used with the module being tested, perform the tests using the 12-lead cable.

1. Patient Leads Current Leakage — measure the leakage current between each of the patient leadwires and the ground lug on the monitor back panel. Also, measure the leakage current between all combinations of ECG leads and ground. The current must be less than 10 μA with the ground connected, and 50 μA with the ground open.
2. Leakage Current to Ground with 50/60 Hz — AC mains voltage applied to leads. Apply AC mains voltage and measure the leakage current between each of the ECG leadwires and the ground lug on the monitor back panel. The current must be less than 50 μA at any line voltage.

Preventive Maintenance

A qualified Spacelabs Medical repair representative or hospital biomedical technician should check the unit and optional equipment for acceptable performance and electrical safety to ensure they operate according to current requirements.

Functional Checks

A power-ON self-test is performed each time the monitor is turned ON. An LED recessed under the lower edge of the Front Bezel assembly (behind the fan filter) will flicker randomly when the monitor is operating properly on the external AC/DC power supply; the LED will be OFF when the monitor is operating on batteries.

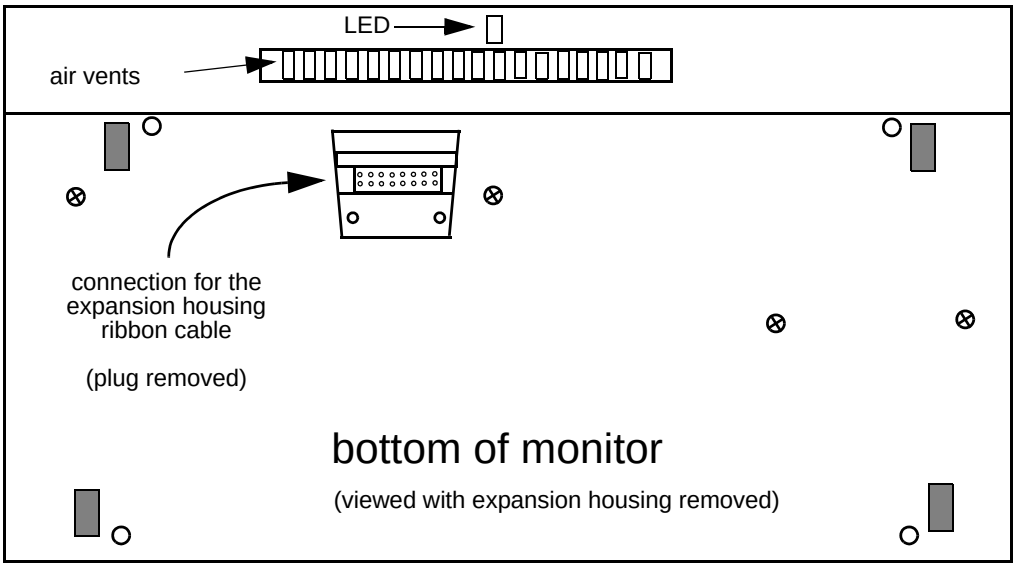


Figure 4-1: Monitor from below

Monitor Functional Tests

This procedure verifies operation of the Recorder Assembly, Expansion Housing, Patient Data Logger, Remote Alarm, and external SDLC options. It assumes that a 90496 Command Module (ECG, RESP, two PRESS channels, and two TEMP channels) are available for testing purposes. In the event that the 90496 Command Module is not available, similar modules may be substituted for verifying specific parameters.

Verifying Monitor Functions

Note:

To begin the test, make sure no modules are installed and the Flexport system is not connected.

1 Power-ON the monitor and verify the following sequence of events:

- A power-ON tone sounds.
- The fan should start running within 60 seconds after power-ON and continue to run as long as the monitor is connected to external power. When the monitor is operating from batteries, the fan will operate only when the monitor is in a high-temperature condition.

2 Insert the 90496 module without a patient cable connected. Verify that the vertical ECG key (also termed the Open Door key) appears on the screen with **???** and the message **LEADS OFF**.

3 Connect a waveform simulator to the ECG input with a patient cable. Set the simulator to a known rate, and verify that the ECG count and the lead being monitored is displayed to the right of the ECG vertical key. Also verify that the ECG waveform appears on the screen.

Optional Recorder Assembly

If the monitor is configured with the optional Recorder assembly, verify that the monitor initiates a recording by touching the RECORD key and then touching one of the flashing parameter keys.

Note:

The printed waveform should be free from defects such as gaps, extra lines, etc. If not, notify a Service Representative for servicing.

Optional Remote Alarm

If the monitor is configured to use the Remote Alarm to interface into a nurse call station, plug the cable into the Remote Alarm connector and initiate an alarm. The nurse call should respond. An alternate method is to connect the cable and cycle power-ON the monitor. The nurse call should momentarily activate.

Optional Ethernet (Wired)

If the monitor is configured to use the wired Ethernet, 10BaseT cable from an active Spacelabs Medical network onto the rear panel connector, press the SPECIAL FUNCTIONS key and verify that other monitors appear in the Remote View submenu.

Optional Wireless Ethernet

If the monitor is configured to use the wireless Ethernet, call up the node name on the “Master” monitor by touching the NODE DIRECTORY key and locating the monitor’s bed name that is attached to the wireless Ethernet (on the master monitor display).

Capnography

Calibration

Required Equipment:

- O_2 sensor (P/N 015-0285-00)*
- O_2 cable (P/N 175-0877-01 or 175-0996-00)*
- O_2 airway adapter (P/N 025-0040-00)*
- CO_2 sensor assembly (P/N 011-0710-00 for -G or 704-0001-00 for -H)
- CO_2 airway adapter (P/N 025-0033-00 or 025-0035-00 for -G or 704-0002-00, 704-0003-00, 704-0004-00, or 704-0005-00 for -H)
- Calibration gas bottle (P/N 006-0382-00 or 006-0179-00)
- A flowmeter
- A pressure regulator for the calibration gas bottle

  ** Some models do not include O_2 capability.*

Setup:

Use the setup as illustrated in *Figure 4-2* on page 4-9.

Procedure:

Perform the following procedure to ensure proper performance of the capnography option using the equipment and setup listed above:

1. Place an airway adapter into the transducer head of the CO_2 sensor and plug it into the capnography connector on the side of the monitor.
2. Verify that gas graphics are displayed in the waveform zone and that the **WARMING UP** message appears.

Note:

*In less than five minutes, the **WARMING UP** message disappears and a flat line waveform is presented.*

1. Breathe through the airway adapter for five slow breaths. Verify that the waveform displayed rises and falls accordingly.
2. Touch the GAS key to verify that the green module LED on the capnograph lights up when the key is active.
3. If the O_2 option is provided, continue with step 6. If the O_2 option is not provided, continue with step 15.
4. Connect the O_2 cable to the O_2 connector on the front panel of the module.
5. Without connecting the O_2 sensor, touch the GAS, CAL, and O2 CAL keys, then touch the ZERO key and verify that the O2 ZERO COMPLETE message is displayed.

6 Attach the O_2 sensor to the O_2 cable. Verify that the O_2 numeric zone appears and displays between 5% and 35% O_2.

7 With the O_2 sensor in room air, touch the ROOM O2 SPAN key. Verify that the **ROOM O2 SPAN COMPLETE** message is displays. Verify that the O_2 reads 21% ±2%.

8 Place the O_2 sensor in an O_2 airway adapter. Connect this to a source of 100% oxygen.

9 Touch the GAS, CAL, and then the O2 CAL keys on the monitor. Watch for the O_2 reading to rise to a value between 85% and 100% and then stabilize. Wait at least 30 seconds.

10 If the value does not reach 85%, check for a weak O_2 sensor. Otherwise, touch the 100% O2 SPAN key.

11 Verify that the **100% O2 SPAN COMPLETE** message is displayed. Verify that the O_2 reads 100% ±2%.

12 Shut off the 100% oxygen supply and disconnect the O_2 sensor and airway adapter from the source of 100% oxygen.

13 Connect a 5% to 10% CO_2, 21% O_2, balance N_2 gas cylinder to a flow meter and then to the CO_2 airway adapter (refer to *Figure 4-2*).

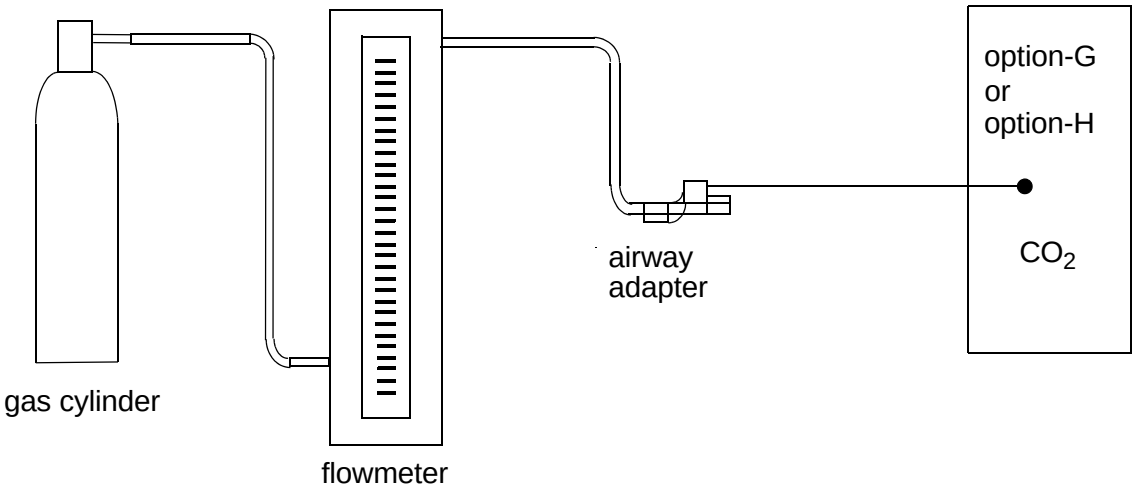


Figure 4-2: Capnography performance test configuration

14 Turn ON the gas supply and verify that the flow through the airway adapter is 300 to 500 ml/min.

15 Allow the reading to stabilize for 15 seconds. Touch the GAS, CAL, and CO2 CHECK keys. While stabilizing, touch the NEXT READING key to read the CO_2 value. Touch the NEXT READING key repeatedly until the value of XX.X in the CO2 XX.X mmHg key stabilizes.

16 Convert the certified contents of the test gas to mmHg using the following formula:

17 CO_2 in mmHg = (CO_2 in Percent from the bottle/100) × (Current barometric reading; the XXX from the BAR. PRESS. XXX mmHg key)

18 Verify that the displayed value for CO_2 in the CO2 XX.X mmHg key is within 4 mmHg.

19 Shut off the CO_2 gas supply and disconnect the CO_2 sensor and airway adapter from the source of the gas.

Part Replacement Procedures

Tools/Test Equipment Needed

- Anti-static mat with wrist strap
- #1 and #2 Phillips screwdriver
- 5/16 inch nut driver
- 3/16 inch nut driver
- Tool for knurled rings (P/N 003-0117-xx)

Setup for Disassembly

1 Remove the DC Power Supply cable and battery(ies) if present.

2 Remove the patient parameter plug-in module.

Replacing the Optional Recorder Assembly

1 Remove the recorder assembly (if installed) by first opening the printer door, loosening the two captive screws, and then pulling out the assembly at the top.

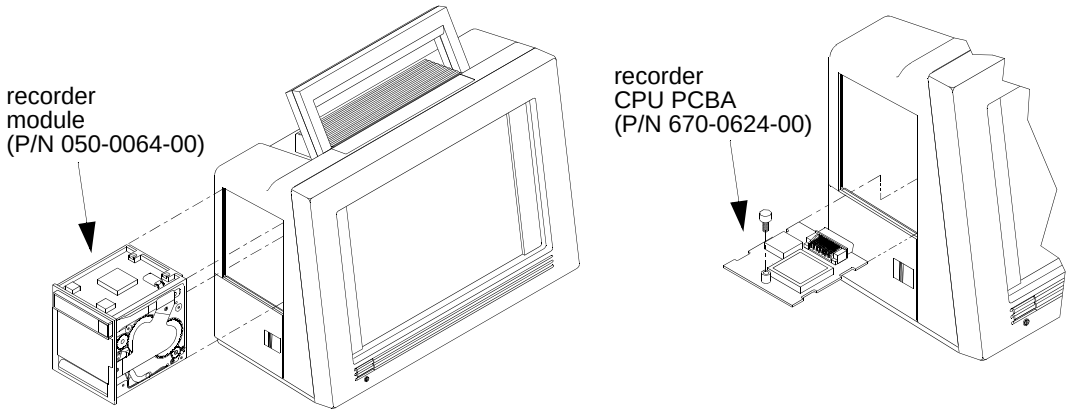


Figure 4-3: Optional recorder assembly

2 If replacing the recorder CPU PCBA, loosen the thumbscrew and pull it forward until it is free of the connector.

Replacing the Main PCBA

1. Remove the bezel as previously described.
2. With the monitor standing upright, remove the eight 6-32 × 1/4" screws (three along the top, three in the center, and two at the bottom of the PCBA).
3. Place your fingers into the space on either side of the upward protrusion of the PCBA (located near the two top mounting screws) and pull. This will free the main PCBA-to-Interconnect PCBA connection.
4. Carefully pull the PCBA from the top until the cables along the bottom of the assembly are visible.
5. Disconnect the three cables and set the PCBA into a static-protected area for further disassembly.
6. Remove the touchscreen flex cable from the main PCBA. Observe cautions regarding flex cable handling.
7. Re-install the PCBA in reverse order.

Removing the Chassis Assembly

The chassis assembly includes the sheet metal Interconnect PCBA, and the fan/battery connection assembly.

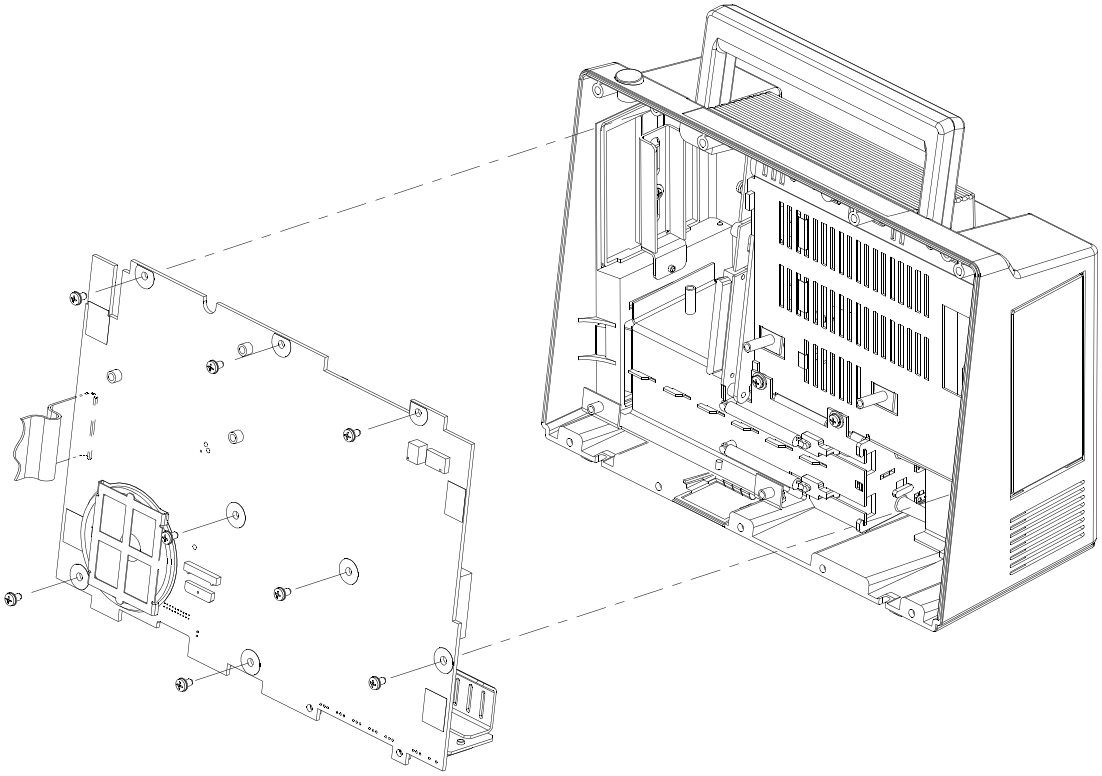


Figure 4-4: Chassis assembly for Ultraview 1030/1050

1. Remove the I/O option panel, bezel, main PCBA, module, and optional recorder and CPU as previously described.
2. Place the monitor face down with the bottom facing you.
3. Remove the screw near the ground terminal area.
4. Remove the two screws with washers from the option area.

Note:

These washers must be used when replacing the screws. If they are left out, the screws will penetrate into the battery chassis and interfere with the battery clearance.

5. Remove the four 6-32 × 0.375 inch screws from the bottom of the monitor.
6. Turn the assembly over and remove the two top screws to secure the wall of the module compartment to the rear housing.

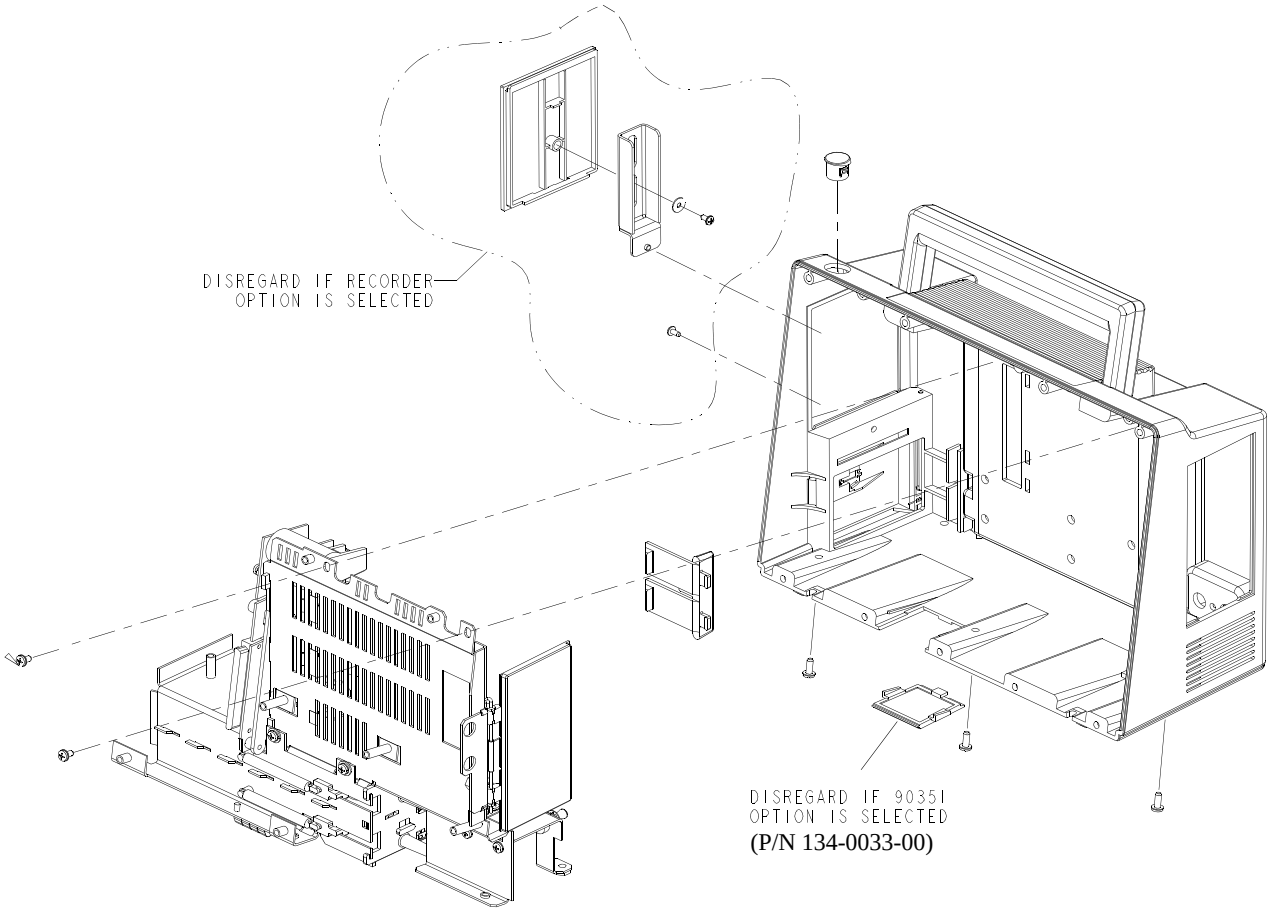


Figure 4-5: Chassis out of the case

7 To lift the chassis out of the case, place your left hand through the battery door and your right hand into the module access opening. Work the assembly upward, allowing the top to move ahead of the bottom.

8 The chassis is now ready for further disassembly.

Replacing the Fan/Battery Contact Assembly

1. Remove the chassis assembly from the housing as previously described.
2. Separate the chassis assembly from the module wall assembly by removing the two screws above the battery ejection springs and the two screws near the bottom.

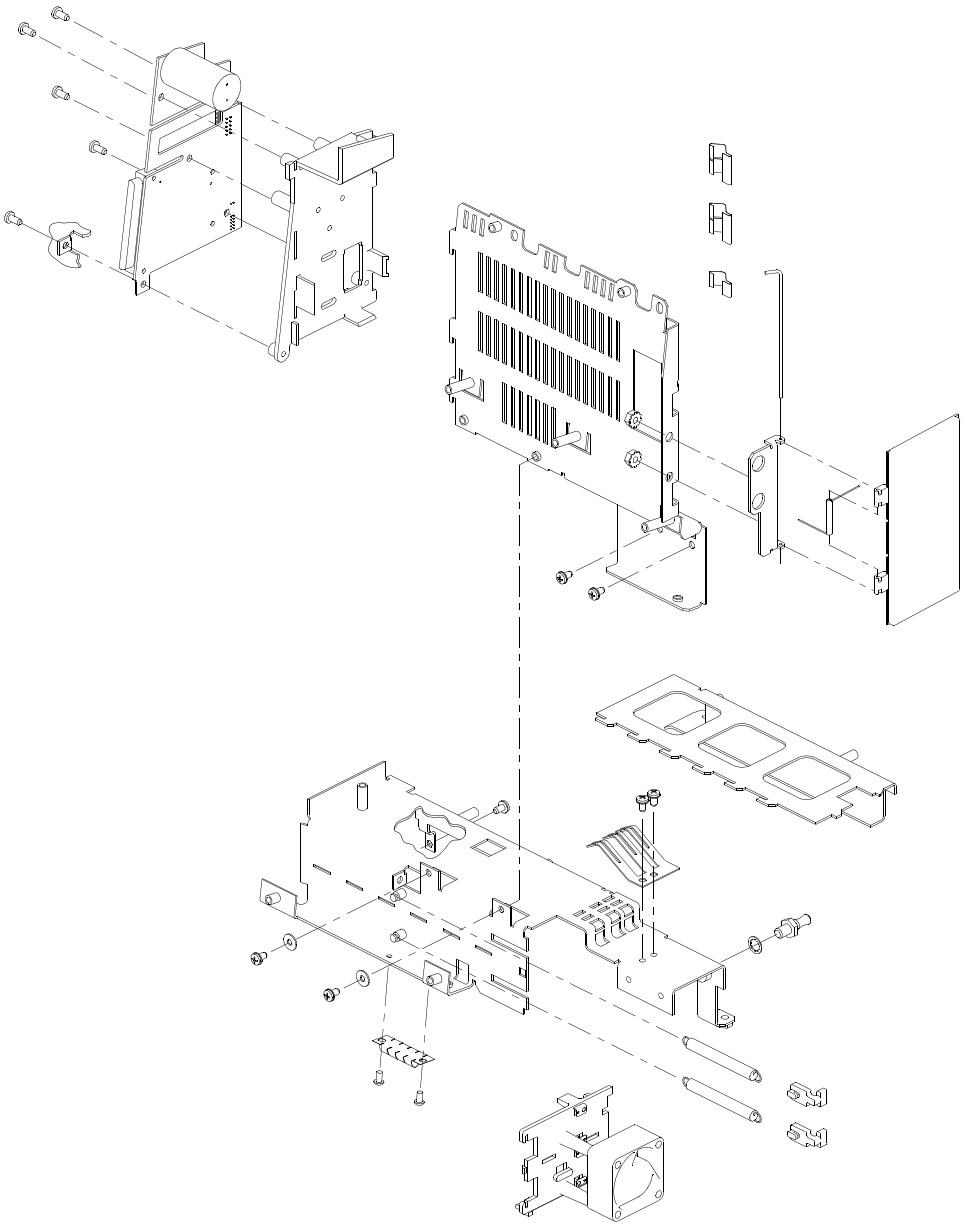


Figure 4-6: Replacing the fan/battery contact assembly

3. Pry up the center retainer on the battery contact assembly (near the battery ejection springs). This should free the fan/battery contact assembly.
4. Remove the screw between the chassis and the interconnect PCBA.

Replacing the Interconnect PCBA and Frame

1 Remove the chassis assembly from the housing as previously described.

2 Separate the chassis assembly from the module wall assembly by removing the two screws above the battery ejection springs and the two screws near the bottom.

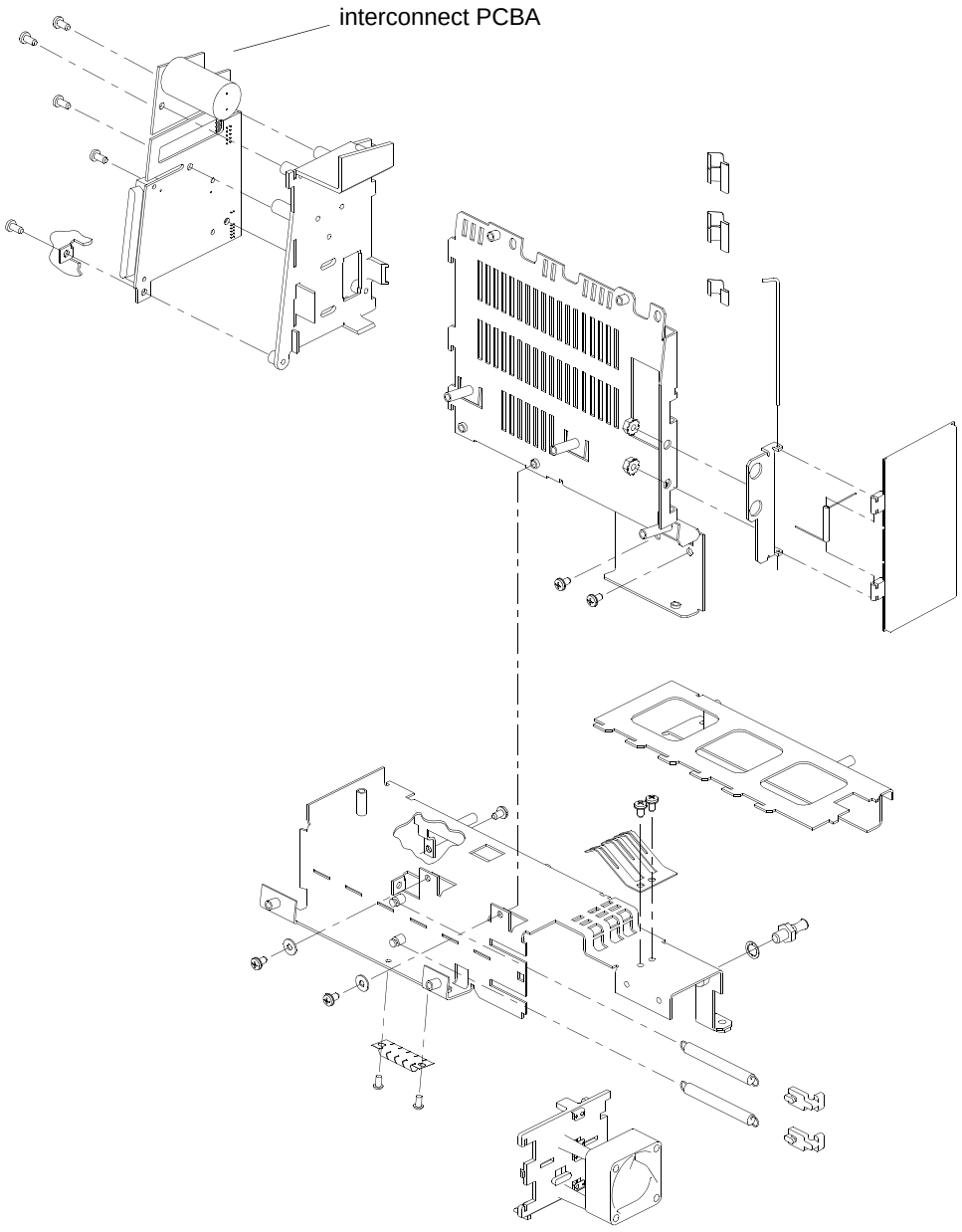


Figure 4-7: Replacing the interconnect PCBA and frame

3 Remove the screw between the chassis and the interconnect PCBA.

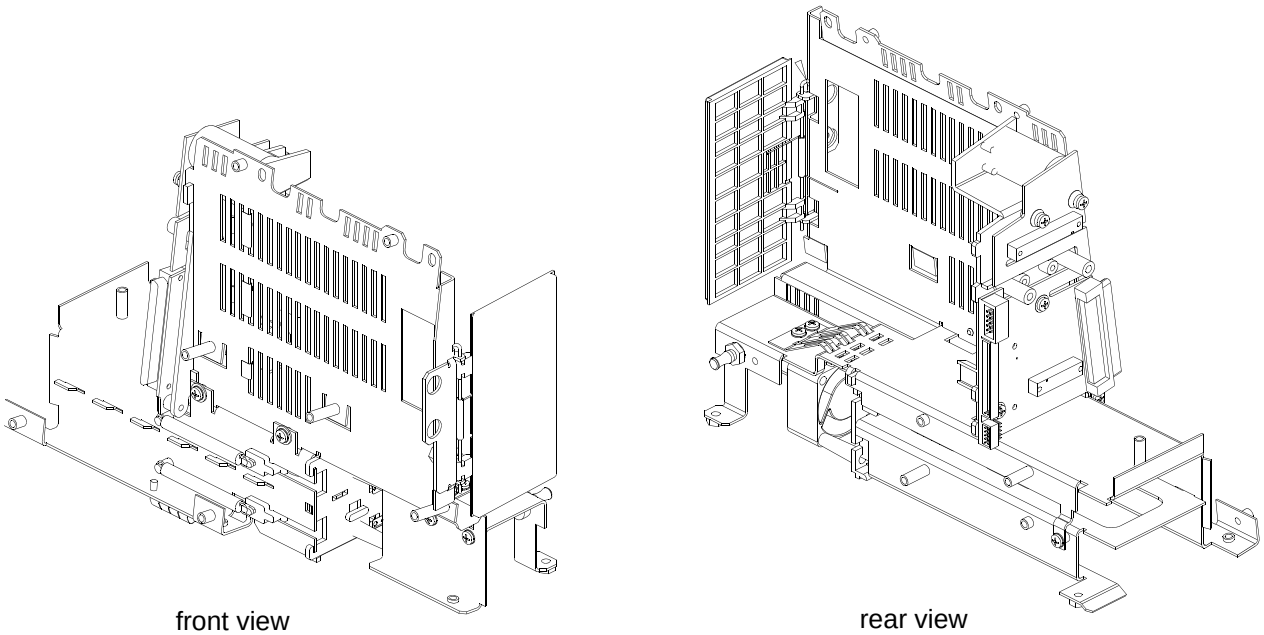
4 Separate the interconnect PCBA and frame.

5 Reassemble the monitor in reverse order.

Replacing/Aligning the Module Door

Removing the Door

1. Remove the two nuts fastening the hinge to the wall of the module compartment assembly. This will free the door assembly. When installing a new door, do not tighten the two nuts until the chassis assembly is completely secured to the rear housing.
2. After the chassis and rear housing are mated, position the door and tighten the two nuts.



front view

rear view

Figure 4-8: Module door

Replacing the I/O PCBA — Option F

Removing the Option Panel

1 Remove the five 6-32 × 1/2 inch screws.

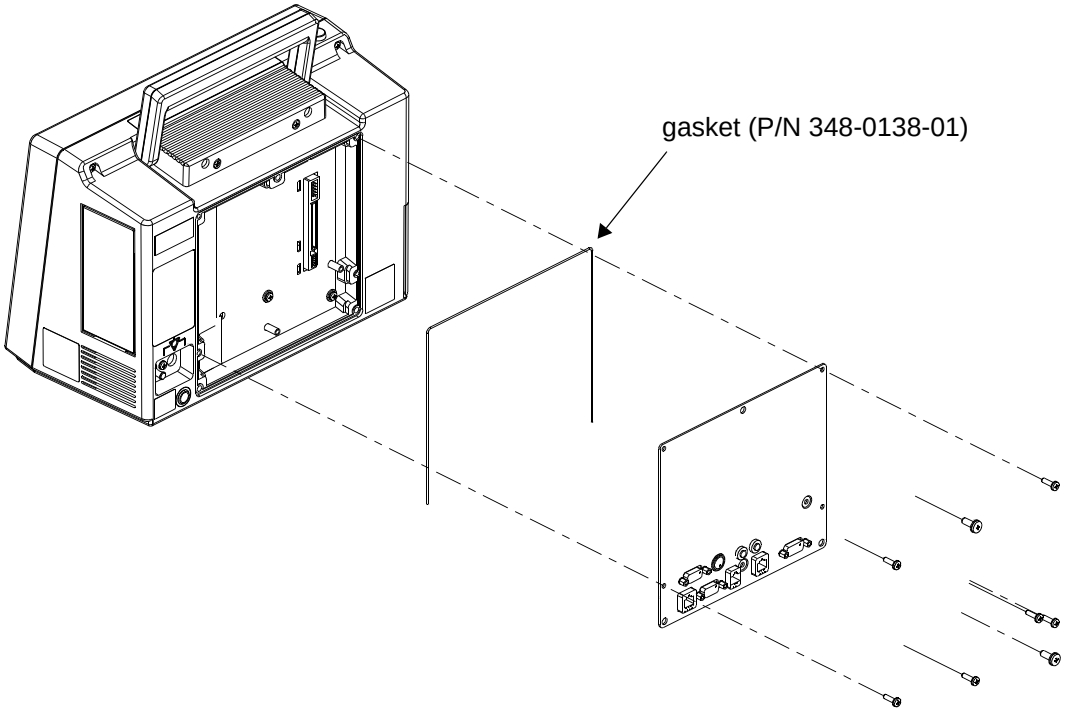


Figure 4-9: Gasket placement

Note:

- *Ensure that the gasket is properly positioned prior to reattaching the option panel.*
- *Your configuration may differ from this illustration.*

1 Remove the two 10-32 × 1/2 inch screws.

2 Carefully remove the option panel to gain access to the interconnection cable.

3 Unplug the interconnection cable.

4 Set the option panel aside for further disassembly.

Removing the I/O PCBA

1 Remove the four 3/16 inch jack screws that secure the SDLC and RS-232 connectors.

2 Remove the three 6/32" × 1/4" screws that secure the I/O PCBA to the option panel.

3 Remove the six jack screws using the appropriate nut driver.

4 Using the tool for knurled rings, (P/N 003-0117-xx) remove the knurled nuts.

5 Reinstall the replacement I/O PCBA in reverse order.

Display or Touchscreen Assembly Replacement

Removing the Bezel

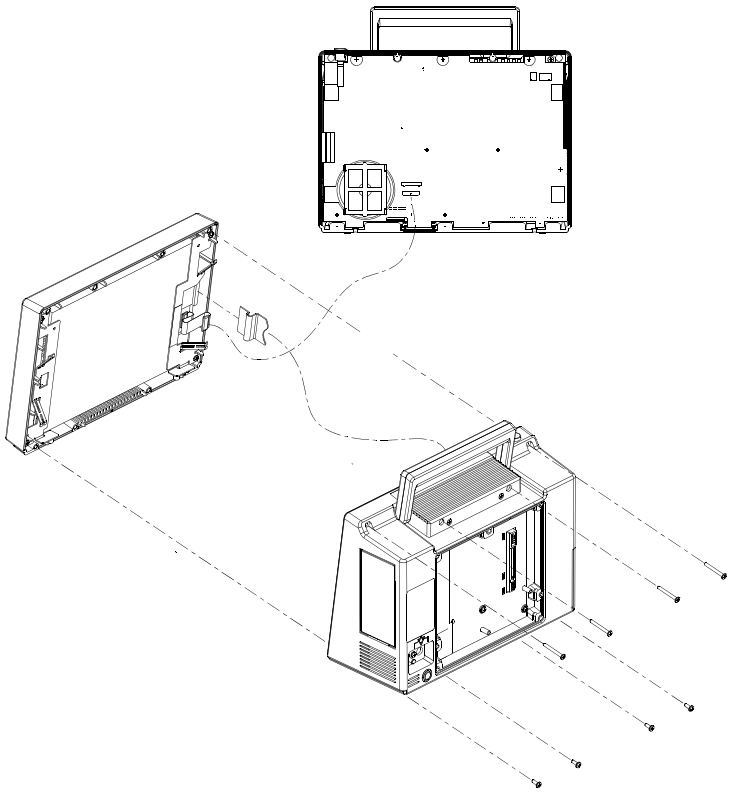


Figure 4-10: Bezel removal

Note:

The handle assembly may remain attached to the rear housing. Access holes are present in the handle enclosure to gain access to the Front Bezel fastening screws.

1. Remove the expansion housing, if present.
2. Remove the four 6-32 × 1 1/4 inch screws from the top rear housing.
3. Remove the four 6-32 × 3/8 inch screws along the bottom rear housing.

Note:

Due to the short length of the inverter cable, remove it prior to fully opening the case.

Caution:

Never pull on the flex cables. This may damage the cable end or the connector.

1 Disconnect the two-wire connector from the main PCBA if the LCD is installed.

2 Disconnect the video cable (small flex cable) from the main PCBA.

3 Disconnect the touchscreen cable (large flex cable) from the touchscreen PCBA. Use finger pressure only. A tool may break the latch.

Note:

Proper operation of the monitor depends upon correct cable re-insertion following disassembly. Ensure that the flex cable is aligned properly and fully inserted into the connector prior to locking the connector tab down.

Removing the Display Bracket Touchscreen Assembly

1 Remove the four screws securing the display assembly to the front bezel.

2 Unsnap (four snaps) the IRTS PCBA assembly from the display support brackets.

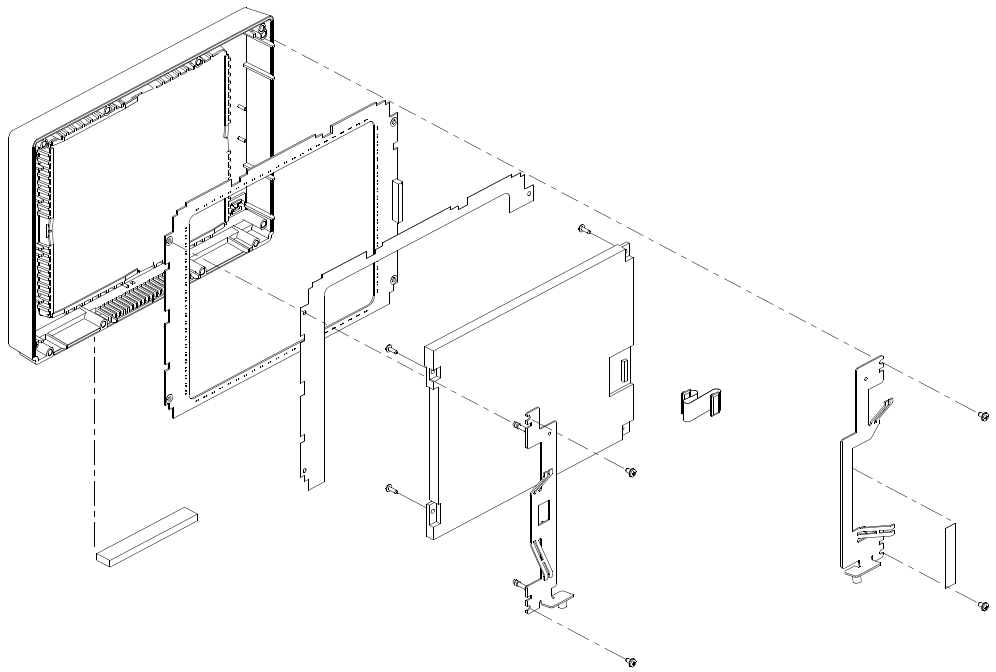


Figure 4-11: Touchscreen display bracket

1 Remove the four screws securing the display to the brackets.

Note:

- *Be careful not to leave finger prints or smudges on the front of the display or on the inside of the front bezel surface.*
- *Do not bend any of the IR devices on the PCBA.*

2 Reassemble the bezel assembly and return it to the monitor.

Capnograph with Ethernet Removal/Disassembly — Option G or H

Removing the I/O Bay PCBA

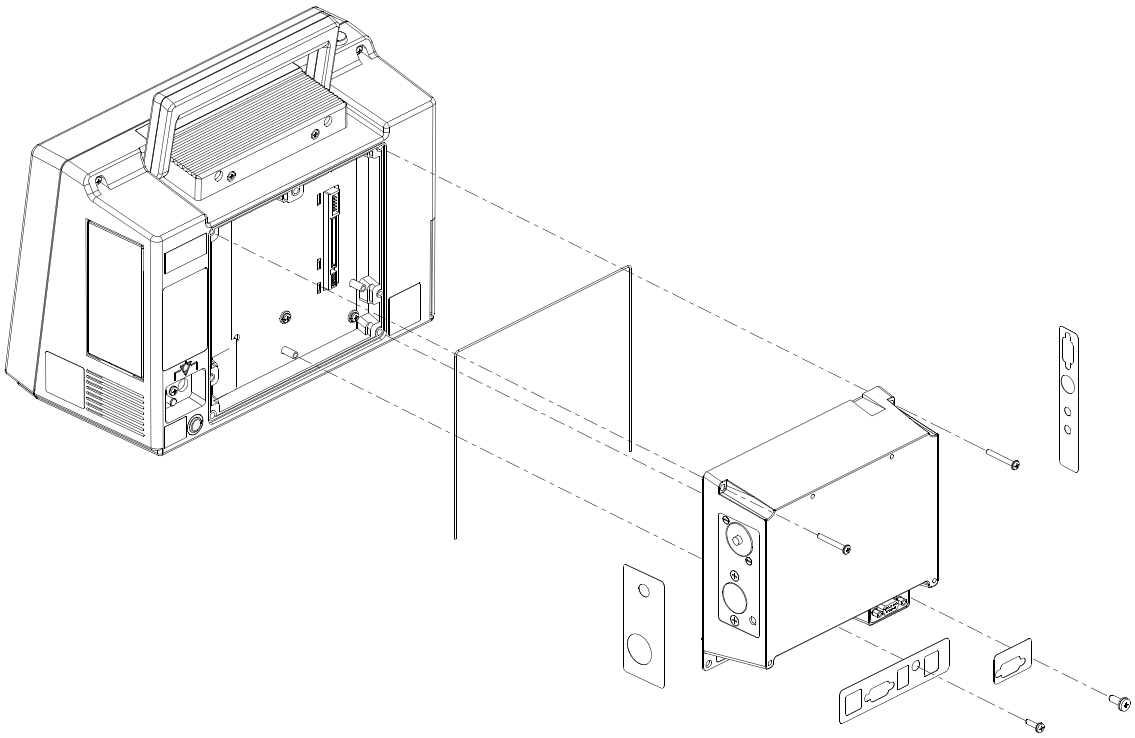


Figure 4-12: Ethernet removal and disassembly

1. Remove the four screws mounting the case to the 90367/90369 housing (two each 6-32 × 1.125 inch; one each 6-32 × 1/2 inch; and one each 10-32 × 1/2 inch).
2. Remove the case and retain the gasket for re-assembly.

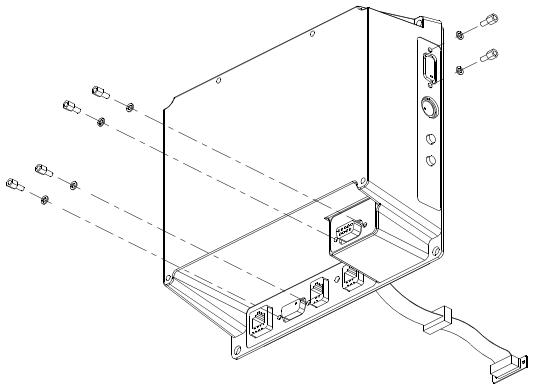


Figure 4-13: Jackscrews and knurled nuts

3 Remove the six jackscrews and the knurled nuts (two each) not shown. The knurled nuts are located on the audio jacks and require a special tool for removal (P/N 003-0117-xx).

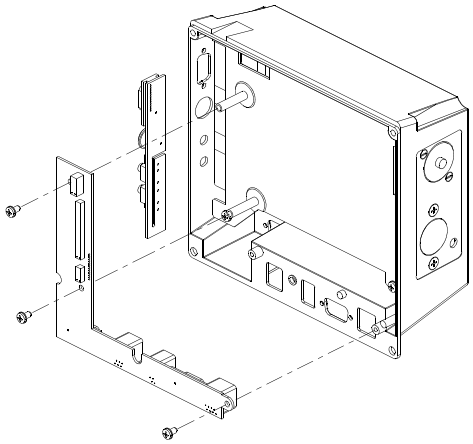


Figure 4-14: Removing the I/O bay PCBA

4 Remove the three 6-32 × 1/4 inch screws holding the I/O bay PCBA.

Removing the Gas Interface PCBA for Option G

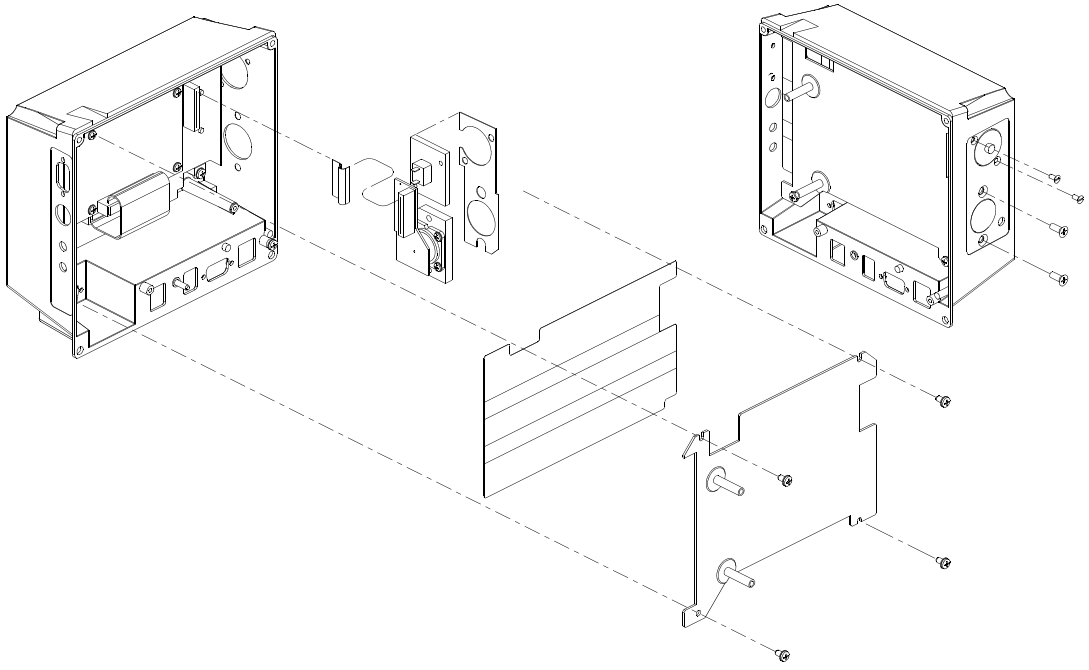


Figure 4-15: PCBA support plate and gas interface PCBA for option G

1 Remove four each 6-32 × 1/4 inch screws holding the support plate to access the gas interface PCBA assembly.

2 Remove the label directly over the assembly on the outside of the case.

3 Remove the four flathead screws under the label.

4 Unplug the cable between J2 and J4 taking appropriate precautions with orientation and connectors.

Removing the CO_2 PCBAs for Option G

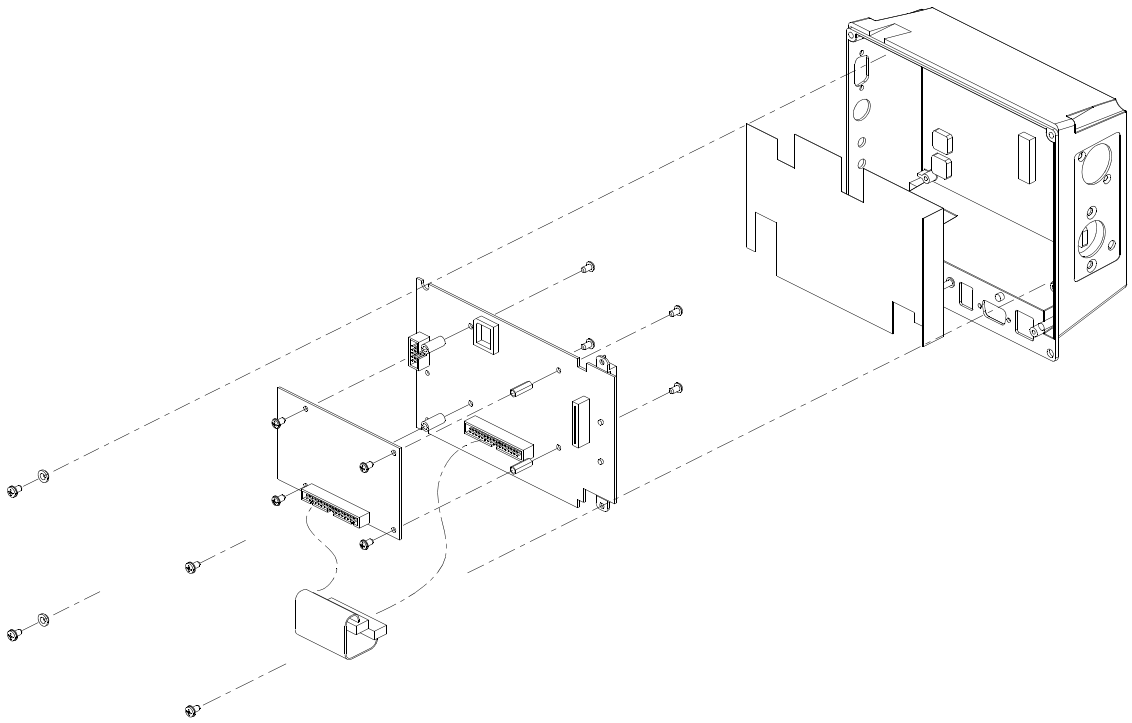


Figure 4-16: CO_2/SDLC PCBA and sensor interface PCBA for option G

1 Remove the four 6-32 × 1/4 inch screws and lift out both PCBAs.

2 Remove the four 4-40 × 1/4 inch screws over the standoffs and separate the sensor interface PCBA from the CO_2/SDLC PCBA.

3 Remove the cable between sensor interface PCBA and the CO_2/SDLC PCBA.

Removing the EMI Interface PCBA for Option H

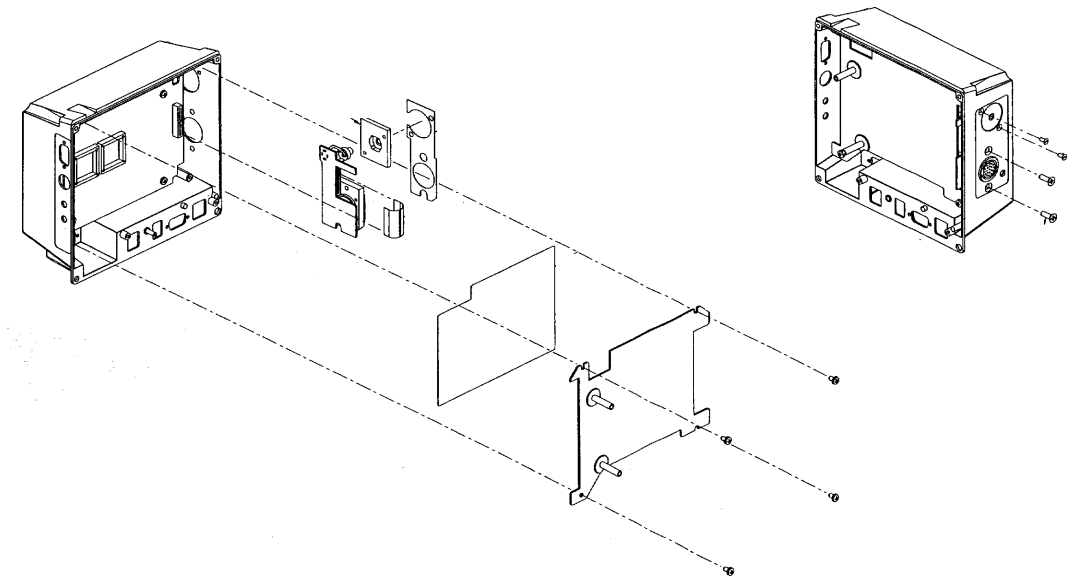


Figure 4-17: PCBA support plate and EMI interface PCBA for option H

1. Remove the four 6-32 × 1/4 inch screws holding the PCBA support plate to access the EMI interface PCBA assembly.
2. Remove the label directly over the assembly on the outside of the case.
3. Remove the four flathead screws under the label.
4. Unplug the cable from J201 of sensor interface PCBA taking appropriate precautions and orientation.

Removing the CO_2 PCBAs for Option H

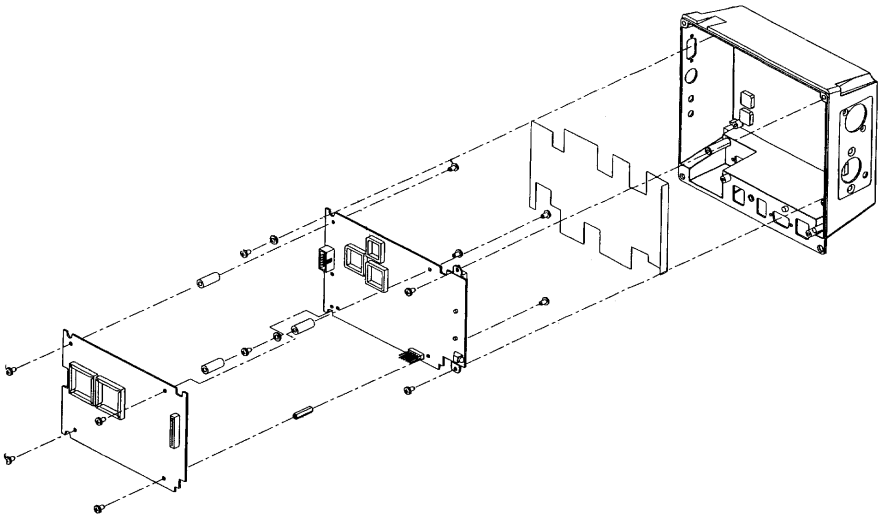


Figure 4-18: CO_2/SDLC PCBA and sensor interface PCBA for option H

1. Remove the four 6-32 × 1/4 inch screws and lift out both PCBAs.
2. Remove the 4-40 × 1/4 inch metal screw and the three 4-40 × 1/4 inch plastic screws over the standoffs and separate the sensor interface PCBA from the CO_2/SDLC PCBA.

Troubleshooting

Contents

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Diagnostic Menus 6
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Diagnostics Failure Messages and Error Codes 11
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Overview

This troubleshooting guide is divided into the sections shown below. The first several sections describe the available diagnostics features and how to use them. This is followed by a section which lists diagnostics failure messages and the suggested corrective actions. The last section gives specific troubleshooting steps which can be used to isolate system failures.

- System Startup
- Boot Menu
- Power ON Diagnostics
- Extended Diagnostics
- Diagnostic Menus
- Diagnostic LED
- Error Log
- Diagnostics Failure Messages & Error Codes
- System Troubleshooting

Caution:

Printed circuit boards in this equipment contain static-sensitive devices. Handle them only at a static-safe workstation.

Note:

Do not touch the screen during power-ON or a touchscreen diagnostic error will occur.

System Startup

When the unit is first powered ON, the following three window system startup screen is displayed.

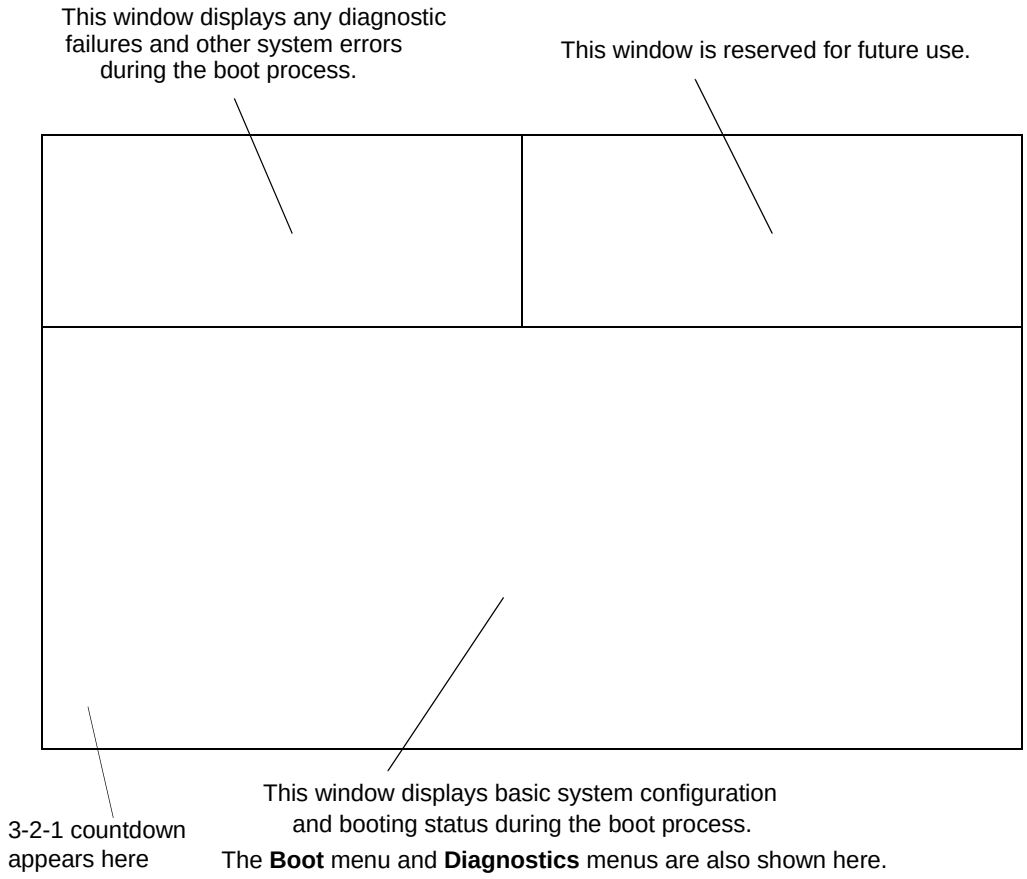

This window displays any diagnostic failures and other system errors during the boot process.
This window is reserved for future use.
3-2-1 countdown appears here
This window displays basic system configuration and booting status during the boot process.
The **Boot** menu and **Diagnostics** menus are also shown here.

Figure 5-1: System Startup window

When this screen is displayed, the unit automatically begins power ON diagnostics. Any diagnostics failures will be reported in the upper left-hand window. Provided no serious diagnostics failures are encountered, the unit will continue past this screen and start normal monitor operation.

A “3-2-1 countdown” is also shown in the **System Startup** window, during which time the booting operation can be halted and a **Boot** menu of boot options can be entered.

The **Boot** menu, and how to enter it, and the power ON diagnostics are explained in the following sections.

Boot Menu

The **Boot** menu allows access to several basic configuration menus and functions of the monitor, including extended diagnostics. The **Boot** menu is activated during system startup and can be controlled using either the touchscreen, mouse, keyboard, or terminal (or a computer with terminal emulation software) connected to the serial port. All text displayed on the screen is also output on the serial port.

To activate the **Boot** menu use one of the following methods:

- With a touchscreen, place a finger into the two lower corners of the display during system startup when you see the “3, 2, 1” countdown.
- With a mouse, click both the left and right mouse buttons during the countdown.
- With the keyboard or terminal, press [Ctrl]+[D] during the countdown (the terminal’s serial port should be set to 9600 baud, no parity, 8 data bits, and one stop bit).

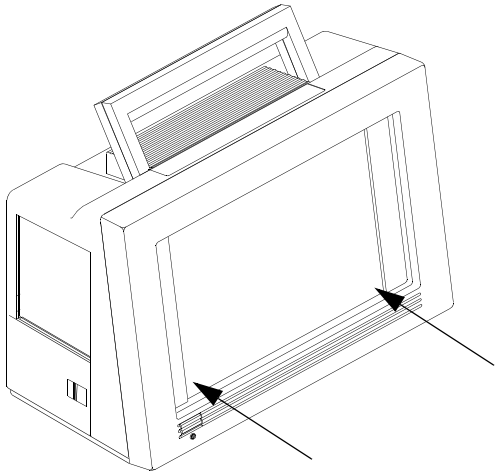


Figure 5-2: Finger placement to initiate boot menu using the touchscreen during the “3,2,1” countdown.

After initiating the **Boot** menu, the following menu appears.

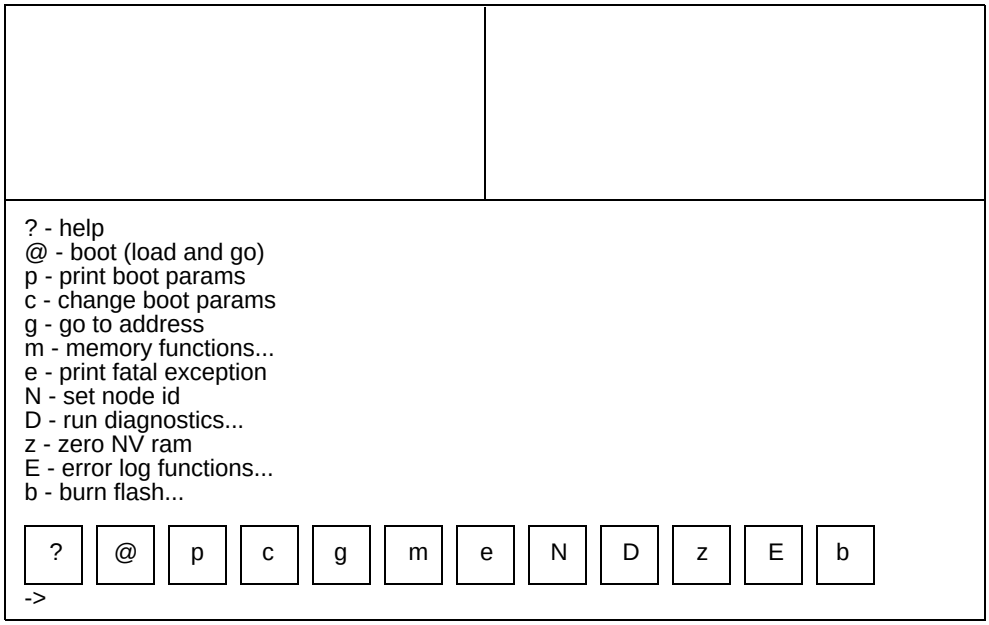

? - help
@ - boot (load and go)
p - print boot params
c - change boot params
g - go to address
m - memory functions...
e - print fatal exception
N - set node id
D - run diagnostics...
z - zero NV ram
E - error log functions...
b - burn flash...
? @ p c g m e N D z E b
->

Figure 5-3: Boot menu

These keys are presented in the **Boot** menu:

? — displays some explanation of this menu.

@ — loads an application file from the network and runs it.

p — prints the boot parameters.

c — allows changing of the boot parameters.

g — begins execution at the address specified.

m — displays the memory submenu; this submenu allows the display, modification, copying, and filling of any memory or address space accessible to the CPU; requires a data key.

e — prints the last fatal exception.

N — allows the node id to be changed.

D — displays the diagnostics main menu; refer to *Diagnostic Menus* on page 5-6.

z — zeros and initialized the NVRAM; requires a data key.

E — displays the error log submenu; this submenu allows the error log to be cleared or dumped to the screen and serial port.

b — displays the burn flash submenu; this submenu allows new boot kernel or application software to be loaded over the network and burned into flash memory.

Note:

*Care must be taken in executing any functions in this menu. The user should only execute Diagnostics (**D**) or use the Error Log (**E**). The rest of the features are generally only for advanced users or Spacelabs Medical field personnel.*

Power ON Diagnostics

Power-ON diagnostic tests verify system hardware integrity during each power-up of a monitor. These tests in themselves can often help isolate and troubleshoot a problem. Most of these tests may also be initiated using the extended diagnostic mode. The diagnostics initiated at power-ON are:

- CPU (reads and writes control registers and does an internal wrap around of one serial communication controller channel)
- DRAM Read/Write (reads and writes DRAM above 1 MB)
- Real time clock (verifies that the clock is running)
- GDS SRAM (reads and writes all of the SRAM, non destructively)
- PCI bridge (reads and writes control registers)
- ISA bridge (reads and writes control registers)
- Video (tests the video memory, the video controller, hsync, and blue video signals)
- Ethernet (comprehensive internal wrap around)
- Flash checksum (checksums all of flash memory)
- Touchscreen (tests the touchscreen controller and the IR detector/emitter pairs)
- Keyboard and mouse controller (reads and writes control registers, runs a self-test, and checks on-card keyboard, and mouse signals)
- Audio (reads and writes control registers in the codec)

Power-ON diagnostics failures are reported in the upper left-hand corner window of the **System Startup** screen. Refer to *System Startup* on page 5-2 for more information.

Any error that occurs during one of these tests is logged in the non-volatile configuration memory. Refer to *Error Log* on page 5-11 to retrieve the log.

Extended Diagnostics

Extended diagnostic tests, like the power ON diagnostics can be used to troubleshoot and isolate many system failures. The kinds of tests and features available in the extended diagnostics are:

- The Power-ON Diagnostics
- Interactive tests and read/write memory tests that are not appropriate during power-ON diagnostics
- Touchscreen calibration and data dump utilities
- System data dump and system reset utilities

The diagnostics menus allow most of these tests to be run individually or all at once. If Loop mode is activated, a test(s) can be executed in a continuous loop. If Halt On Error mode is activated, then the looping stops when a diagnostic failure is detected. To avoid false failures, do not use the touchscreen, mouse, or keyboard while the diagnostics are executing.

Extended diagnostics failures are reported in the upper left-hand corner window of the **System Startup** screen. Refer to *System Startup* on page 5-2 for more information.

Any error that occurs during one of these tests is logged in the non-volatile memory. Refer to *Error Log* on page 5-11 to retrieve the log.

For detailed information on the extended diagnostics and how to run them, refer to *Diagnostic Menus* on page 5-6.

Diagnostic Menus

Touch the D key in the **Boot** menu to display the **Main Diagnostic** menu:

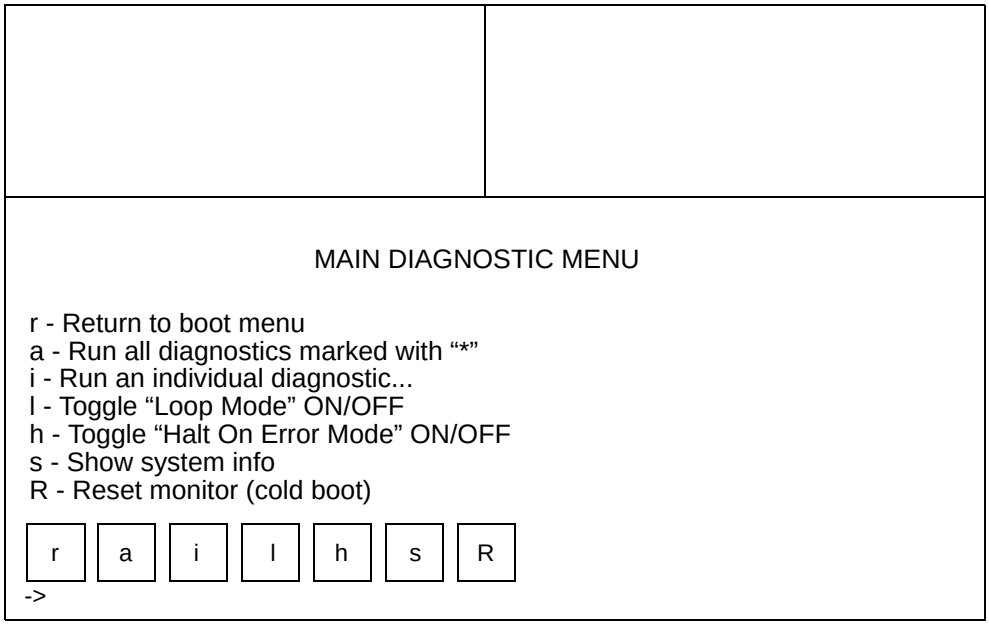


Figure 5-4: Main Diagnostic menu

The following functions are available in this menu:

r — returns to the **Boot** menu.

a — runs all the diagnostics that are marked with an asterisk in the individual diagnostics submenus; these tests are identical to the power-ON diagnostic tests; alternate CPU and DRAM tests are available in the submenus.

i — displays the individual diagnostic submenu (described in detail below).

l — toggles Loop mode ON or OFF; when Loop mode is ON, any test or tests that are selected will run in a continuous loop until power is cycled.

h — toggles Halt On Error mode ON or OFF; when ON, any failure that occurs while tests are running in Loop mode immediately stops testing.

s — shows system information, including details of address spaces and variables used in the system.

R — Causes a cold boot reset just like cycling power.

Touch the **i** in the **Diagnostic** main menu to present the **Individual Diagnostic** menu:

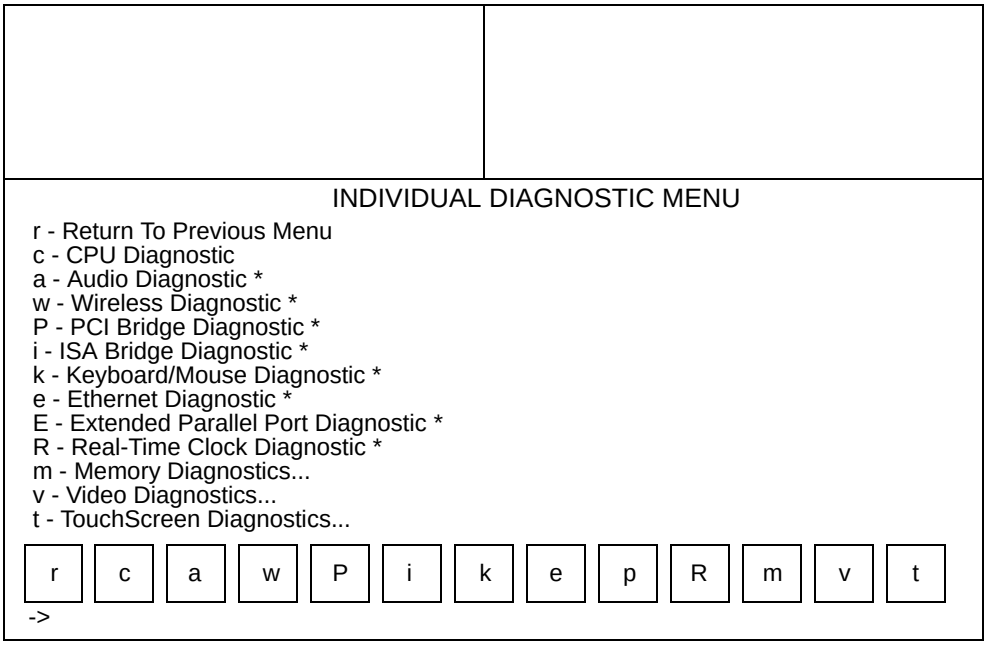


Figure 5-5: Individual Diagnostic menu

The following keys are available in this menu:

r — returns to the **Main Diagnostics** menu.

c — tests certain CPU functions; similar, but not identical to, the power-ON CPU test.

a — runs the power-ON audio diagnostic.

w — runs the power-ON wireless LAN diagnostic (if installed).

P — runs the power-ON PCI bridge test.

I — runs the power-ON ISA bridge test.

k — runs the power-ON keyboard and mouse test.

e — runs the power-ON Ethernet test.

E — runs the power-ON extended parallel port (EPP) test.

R — tests that the real time clock is running.

m — brings up the memory diagnostics submenu; requires a data key.

v — brings up the video diagnostics submenu.

t — brings up the touchscreen diagnostics submenu.

Touch the **m** key in the **Individual Diagnostic** menu to present the **Memory** menu:

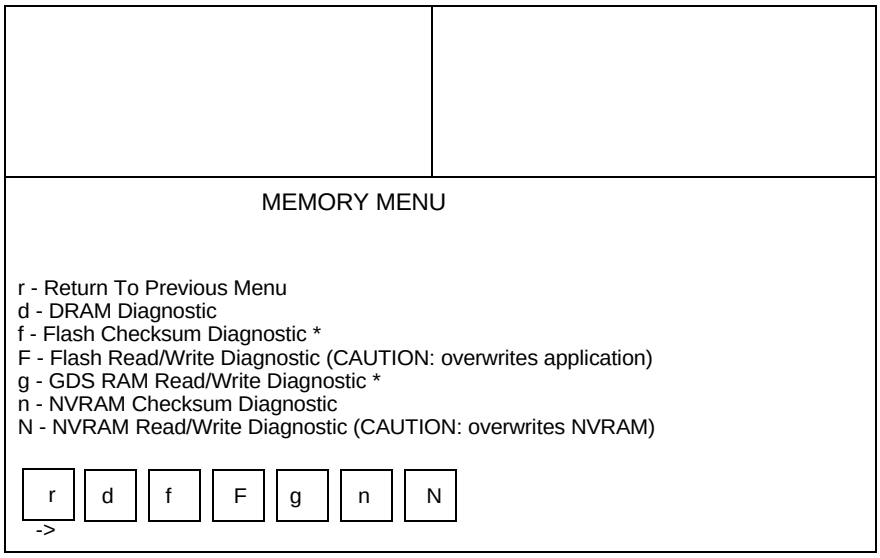


Figure 5-6: Memory menu

The following keys are available in this menu:

r — returns to the **Individual Diagnostics** menu.

d — runs a DRAM test; similar to the power-ON DRAM test, but tests only the memory not in use by the boot kernel.

f — performs the power-ON flash checksum.

F — does a read/write test on the application area of flash memory; overwrites the application software, so it will have to be reloaded after the test; requires a data key.

g — runs the power-ON GDS SRAM test.

n — does a checksum on the NVRAM.

N — performs a read/write test of the NVRAM; this overwrites configuration parameters in the NVRAM, so after the test the NVRAM should be zeroed and the boot parameters and sysgen values should be re-entered; requires a data key.

Touch the **v** key in the **Individual Diagnostic** menu to present the **Video** menu:

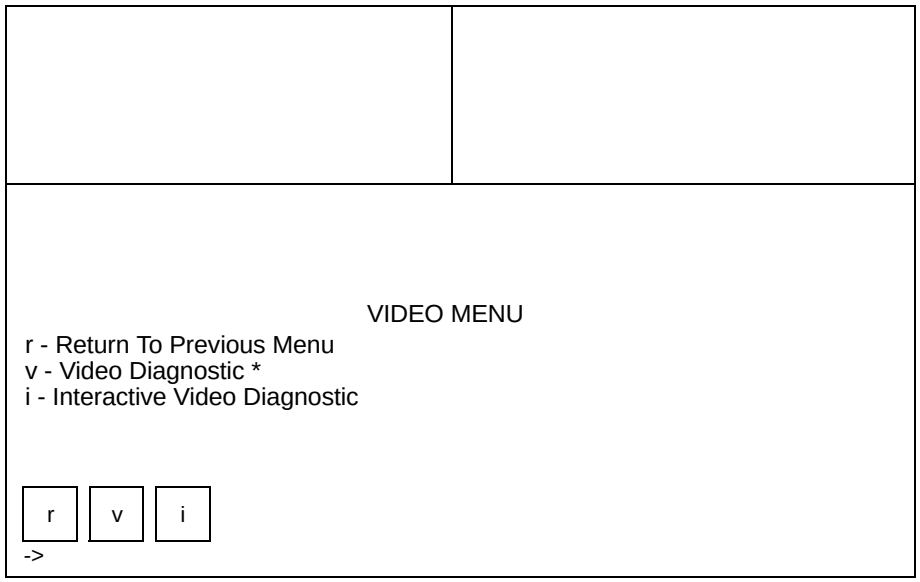


Figure 5-7: Video menu

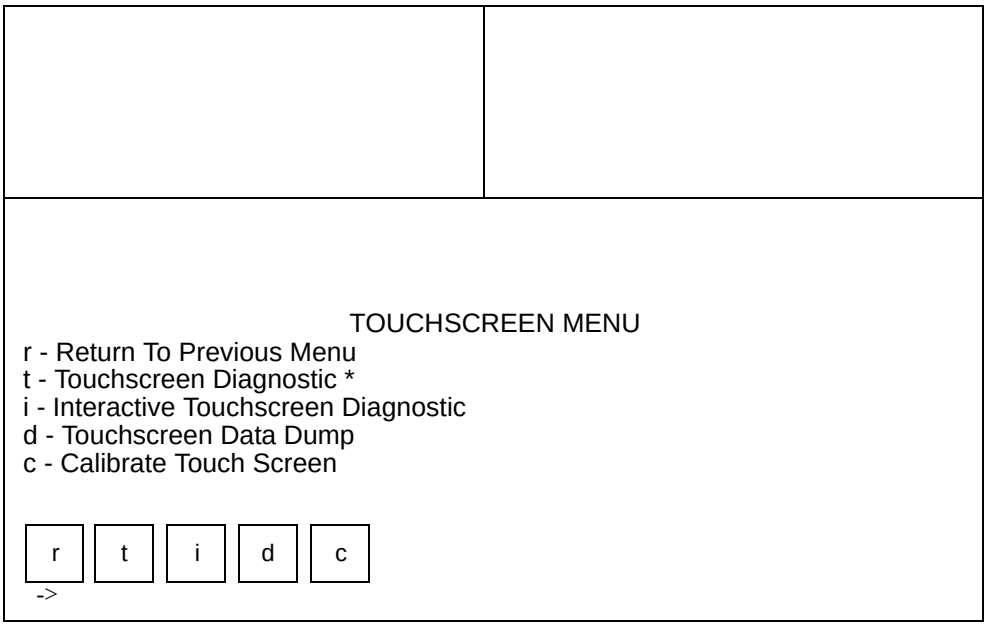
The following keys are available in this menu:

r — returns to the **Individual Diagnostics** menu.

v — runs the power-ON video diagnostic.

i — runs an interactive video diagnostic; this displays red, green, blue, white, and black screens, each for 5 seconds; the screen must be inspected for faulty pixels.

Touch the **t** key in the **Individual Diagnostic** menu to present the **Touchscreen** menu:


TOUCHSCREEN MENU
r - Return To Previous Menu
t - Touchscreen Diagnostic *
i - Interactive Touchscreen Diagnostic
d - Touchscreen Data Dump
c - Calibrate Touch Screen
r
t
i
d
c
->

Error Log

For troubleshooting intermittent problems, the monitor maintains a text error log for both recoverable and non-recoverable errors in its battery-backed, non-volatile memory. All diagnostics failures are logged in the error log. Other error codes that may be in the log are used for software development and application and have no value in hardware troubleshooting.

Most errors relate to the CPU PCBA, but some errors may be caused by the patient parameter module or software errors. For example, a particular sequence of key strokes that always produces the same error code could be a software problem.

Displaying the Error Log

Before using the error log, ensure that all other procedures have been followed, including elimination of operator errors, testing of voltages, correction of display faults, diagnostic testing, cabling/connector repairs, software compatibility, etc.

From the **Boot** menu (refer to *Boot Menu* on page 5-3) press **E** to access the **ERROR LOG FUNCTIONS**, then d to view the error log.

Clearing the Error Log

To clear the error codes, press **E**, then press **c**.

Diagnostics Failure Messages and Error Codes

When the monitor fails power-ON diagnostics, extended diagnostics or blinks an error code on the Diagnostics LED, do the following:

1. Verify the failure by powering the unit OFF and ON again or by running the extended diagnostics as described in the *Extended Diagnostics* on page 5-5 and the *Diagnostic Menus* on page 5-6.
2. Upon verification of the failure, take troubleshooting action or replace FRUs based on the following diagnostics failure messages.

Table 1: Diagnostic Failure Messages

Error Code	Diagnostics Failure Message	Suggested Action
01030000	*Diagnostics Passed*	No action required.
01030001	*Diagnostic(s) Failed; degraded performance*	Monitor functional but in need of repair. Some features may not be available. Replace CPU PCBA.
01030002	*Critical Failure*	Replace CPU PCBA.
01030003	*Can't diagnose at this boot stage*	No information available.

Table 1: Diagnostic Failure Messages (continued)

Error Code	Diagnostics Failure Message	Suggested Action
01030100	*Diagnostics Port Test Failed*	Replace CPU PCBA.
01030200	*860 Test Failed*	Replace CPU PCBA.
01030201	*860 SCC Transmit Failed*	Replace CPU PCBA.
01030202	*860 SCC configuration not recognized*	Replace CPU PCBA.
01030300	*DRAM Test Failed*	Replace CPU PCBA.
01030301	*DRAM Test can't allocate memory*	Reboot and retest. If problem persists, replace CPU PCBA.
01030400	*GDS RAM Test Failed*	Replace CPU PCBA.
01030500	*FLASH ROM Test Failed*	Replace CPU PCBA.
01030501	*FLASH ROM boot checksum larger than flash*	Reburn boot kernel software into flash memory and retest. If failure persists, replace CPU PCBA.
01030502	*FLASH ROM app checksum larger than flash*	Reburn application software into flash memory and retest. If failure persists, replace CPU PCBA.
01030503	*FLASH ROM boot checksum error*	Reburn boot kernel software into flash memory and retest. If failure persists, replace CPU PCBA.
01030504	*FLASH ROM app checksum error*	Reburn application software into flash memory and retest. If failure persists, replace CPU PCBA.
01030505	*FLASH ROM read/write memory test error*	Replace CPU PCBA.
01030600	*Power Subsystem Test Failed*	Replace CPU PCBA.
01030601	*A2D Converter failed to convert*	Replace CPU PCBA.
01030602	*Invalid Power Request*	Replace CPU PCBA.
01030603	*Temperature out of spec*	Replace CPU PCBA.

Table 1: Diagnostic Failure Messages (continued)

Error Code	Diagnostics Failure Message	Suggested Action
01030700	*PCI Bridge Test Failed*	Replace CPU PCBA.
01030701	*PCI Bridge configuration not recognized*	Replace CPU PCBA.
01030702	*PCI Bridge registers are not writable*	Replace CPU PCBA.
01030703	*PCI Bridge revision not valid for clinical use*	Replace CPU PCBA.
01030800	*Ethernet Test Failed*	Replace CPU PCBA.
01030801	*Ethernet Setup Failed*	Replace CPU PCBA.
01030802	*Ethernet Transmit Failed*	Replace CPU PCBA.
01030900	*ISA Bridge Test Failed*	Replace CPU PCBA.
01030A00	*Video Test Failed*	Replace CPU PCBA.
01030A01	*Invalid Display Type*	Replace CPU PCBA.
01030A02	*Invalid Display Size*	Replace CPU PCBA.
01030A03	*Video configuration not recognized*	Replace CPU PCBA.
01030A04	*Video DRAM failure*	Replace CPU PCBA.
01030A05	*Video could not detect hsync signal*	Replace CPU PCBA.
01030A06	*Video could not detect blue video signal*	Replace CPU PCBA.
01030B00	*Couldn't open IRTS device driver*	Reboot and retest. If problem persists, replace CPU PCBA.
01030B01	*IRTS interface failed*	Replace CPU PCBA.
01030B02	*IRTS ring PCBA interface failed*	Replace CPU PCBA.
01030B03	*IRTS IR pair failed*	Re-calibrate the touchscreen and retest. If problem persists, replace IRTS PCBA/ bezel.
01030B04	*IRTS reset failed*	Replace CPU PCBA.
01030B05	*IRTS change mode failed*	Replace CPU PCBA.

Table 1: Diagnostic Failure Messages (continued)

Error Code	Diagnostics Failure Message	Suggested Action
01030B06	*IRTS uP RAM failed*	Replace CPU PCBA.
01030B07	*IRTS uP ROM failed*	Replace CPU PCBA.
01030B08	*IRTS data dump failure*	Replace CPU PCBA.
01030B09	*Interactive IRTS test failure*	Replace CPU PCBA.
01030B0A	*IRTS ALU error*	Replace CPU PCBA.
01030B0B	*IRTS Remote Keypad ALU error*	Replace CPU PCBA.
01030B0C	*IRTS ALU warning status, please calibrate*	Re-calibrate the touchscreen and retest. If problem persists, replace IRTS PCBA/ bezel.
01030C00	*OS error while diagnosing KBD*	Reboot and retest. If problem persists, replace CPU PCBA.
01030C01	*Can't access KBD device registers*	Replace CPU PCBA.
01030C02	*KBD didn't respond to command*	Replace CPU PCBA.
01030C03	*KBD failed selftest*	Replace CPU PCBA.
01030C04	*KBD failed interface test*	Replace CPU PCBA.
01030D00	*Cant access AUDIO device registers*	Replace CPU PCBA.
01030D01	*Could not open audio device*	Reboot and retest. If problem persists, replace CPU PCBA.
01030D02	*Audio device didn't respond correctly*	Replace CPU PCBA.
01030D03	*Audio Loopback test failed*	Replace CPU PCBA.
01030E00	*NVRAM Test Failed*	Replace CPU PCBA.
01030E01	*NVRAM Clock Not Running*	Replace CPU PCBA.
01030E02	*NVRAM Checksum error*	Zero the NVRAM and reboot. If problem persists, replace CPU PCBA.

Table 1: Diagnostic Failure Messages (continued)

Error Code	Diagnostics Failure Message	Suggested Action
01030E03	*NVRAM read/write memory test failed*	Replace CPU PCBA.
01030F00	*Wireless card diagnostic failed*	Replace CPU PCBA.

System Troubleshooting

This section describes troubleshooting procedures which can be used in conjunction with or separately from the diagnostics to isolate a failure.

Caution:

When troubleshooting, partial disassembly may be required. Ensure that the external power supply and rechargeable battery(s) are disconnected. When disassembling the monitor, use a nonconductive shield to insulate the main PCBA from the front bezel assembly (a piece of cardboard will suffice).

Display Troubleshooting

No Display or Touchscreen Response

1. Make sure the external AC to DC power supply is properly connected (the green light on the monitor front panel should be lighted). If the green light is OFF, troubleshoot the external power supply.
2. Cycle the front panel power ON/OFF switch several times, and verify that a tone is produced each time the switch is depressed. If no tone is produced, carefully pry the button cover from the front bezel assembly and verify that the button movement is free of contaminants. Try pressing the button without the button cover installed. If this does not resolve the problem, continue to step 3.
3. Remove the plug-in patient parameter module. Cycle the power switch to obtain a tone. If no tone is obtained, sequentially remove each of the following assemblies, cycle power and check for a tone before removing the next assembly.
   - The Plug-in optional recorder assembly and its CPU PCBA.
   - The IO bay option panel.

   If the tone returns after removing one of these assemblies, repair or replace that assembly. If the tone is still not produced, go to step 4.

   If The Monitor Produces a Power-ON Tone But No Display is Present:
4. Observe the LED that is below the bottom center of the display; this LED can be seen through a small viewing hole. Also the LED will shine onto the surface that the monitor is placed on.
5. If the LED is not flashing during boot up and there is no display, then the main PCBA or the front bezel is defective.

Caution:

- **When troubleshooting, partial disassembly may be required. Ensure that the external power supply and rechargeable battery(ies) are disconnected. Use a nonconductive shield to insulate the main PCBA from the front bezel assembly (a book or piece of cardboard will suffice).**
- **The ends of the cables that connect front bezel the main PCBA to the touchscreen and the display must be handled with care. When disconnecting these cables, the latch should be gently lifted using finger pressure. A broken latch will still lock the cable into the connector, but it will not provide guidance for centering the cable into the connector.**

6 Remove the front bezel assembly. Once the main PCBA is accessible, check the cable connections between the display and the main PCBA, and verify that the backlight is visible.

If the entire display is garbled or distorted:

- Check the cables and connectors interfacing the display to the main PCBA. A patient parameter module may need to be installed to view the top half of the display. If the connections are OK, replace first the main PCBA, then the display screen.

Caution:

Please do not attempt to troubleshoot the display backlight electronics. There are very HIGH AC voltages in this area. Only qualified Spacelabs Medical personnel should attempt to troubleshoot this section.

Touchscreen Troubleshooting

Required Tools/Test Equipment

#1 Phillips screwdriver

If the display is present but the touchscreen is unresponsive:

1 Check that the surface of the display screen is clean and clear of tape or other foreign material that might block the infrared beams.

2 Calibrate the touchscreen (refer to *Diagnostic Menus* on page 5-6) using the mouse or keyboard. Check the operation again.

3 Run the Interactive Touchscreen test (refer to *Diagnostic Menus* on page 5-6). All beam markers should appear. If some do and others do not, the touchscreen PCBA is faulty.

4 Remove the external power supply and battery(ies) and check the connections interfacing the touchscreen to the main PCBA. If the connections are okay, first replace the Infrared touchscreen (IRTS) PCBA, and then the main PCBA.

Module Slot Troubleshooting

1. Independently verify the module's operation on another unit (if available).
2. Check the software versions of all installed modules, Flexport system interfaces, and other SDLC equipment attached, verifying that there are no incompatibilities.
3. Inspect the interconnect PCBA. If any connectors or parts appear damaged, replace the damaged assembly.
4. If the problem persists, replace the CPU PCBA.

SDLC Output Troubleshooting

1. Verify that the proper SDLC terminations are set and that the proper cables are being used (refer to *Setup* on page 2-1 for more information).
2. Check the software versions of all installed modules, Flexport system interfaces, and other SDLC equipment attached, verifying that there are no incompatibilities.
3. Inspect the I/O bay PCBA and the interconnect PCBA. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.
4. If the problem persists, replace the CPU PCBA.

Ethernet Troubleshooting

1. Check the Ethernet setup and verify that a proper equipment ID, equipment name, and subnet name were entered. Cycle power to reconfigure the system if these are changed.
2. Check that the Ethernet cable is attached to a multiport that is ON and functional.
3. Run the Ethernet diagnostic (refer to *Diagnostic Menus* on page 5-6). If it fails, replace the CPU PCBA.
4. Inspect the I/O bay PCBA and the interconnect PCBA. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.

Wireless Option Troubleshooting

1. Verify that the wireless network is properly configured and the wireless network parameters have been properly set.
2. Before opening the unit, run the wireless card diagnostic (refer to *Diagnostic Menus* on page 5-6). Note the results for later.
3. Verify that the antenna cable is plugged into the wireless card, and that the other end is screwed onto the antenna.

4 Verify that the wide, flat flex cable connecting the wireless card to the CPU PCBA is fully inserted at both ends.

   a If the flex cable is connected and the wireless diagnostic said that the wireless card is not present, replace the flex cable.

   b If the flex cable is connected and the diagnostic said the test failed, replace the wireless card and the flex cable.

   c If the flex cable is connected and the diagnostic passed, replace the wireless card.

5 If the above does not solve the problem, replace the CPU PCBA.

External Alarm Troubleshooting

1 Independently verify the operation of the nurse call box. Replace if it does not work correctly.

2 Verify that the alarm cable is installed correctly and that pin 4 on the connector has +12 V.

3 If the problem persists, inspect the I/O bay PCBA and the interconnect PCBA. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.

4 If the problem persists, replace the CPU PCBA.

Remote Display Troubleshooting

1 Check the external monitor power and video cables for proper connections. Verify that the display assembly is set in the right operating mode (RGB analog video, separate vertical and horizontal sync).

2 Verify that the external monitor brightness, vertical, and horizontal sync are set correctly.

3 Verify that the external monitor's terminations are set for 75 ohms, if settable.

4 Run the video diagnostic (refer to *Diagnostic Menus* on page 5-6). If it fails, replace the CPU PCBA.

5 Inspect the interconnect PCBA and I/O bay PCBAs. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.

Mouse or Keyboard Troubleshooting

1 Try another mouse or keyboard (there is no setup for the mouse or keyboard, either externally or internally). Cycle the power ON and OFF after changing the keyboard or mouse to guarantee that they are seen by the monitor.

2 Run the keyboard/mouse diagnostic (refer to *Diagnostic Menus* on page 5-6). If it fails, replace the CPU PCBA.

3 Inspect the interconnect PCBA and I/O bay PCBAs. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.

Audio Line Output Troubleshooting

1. Independently verify the operation of the equipment being connected to the audio line output. Replace it if necessary.
2. Run the audio diagnostic (refer to *Diagnostic Menus* on page 5-6). If it fails, replace the CPU PCBA.
3. If the external equipment is known to work correctly, enable the key tones on the monitor and press several touchscreen keys. If tones are not heard through the internal speaker, replace the CPU PCBA. If tones are heard, inspect the interconnect PCBA and I/O bay PCBAs. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.

Audio Line Input Troubleshooting

1. Independently verify the operation of the equipment being connected to the audio line input. Replace it if necessary.
2. If the external equipment is known to work correctly, inspect the interconnect PCBA and I/O bay PCBAs. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.
3. If this does not correct the problem, replace the CPU PCBA.

Battery Troubleshooting

The 1030/1050 Monitor can assist in troubleshooting failed batteries in several ways. It can detect gross failures, such as shorted and weak batteries and batteries that cannot hold a charge. It cannot detect all battery failure modes. To debug a problem battery, run the following tests:

Battery Charging Test

1. Install one or two suspect batteries.
2. Power the monitor from the AC power supply and switch the monitor OFF; the front panel LED will be ON or blinking.
3. Let the batteries go through a complete charge cycle: for batteries that are initially charged, wait for at least 1 hour and 40 minutes; for batteries that are initially uncharged, wait for at least 3 hours.
4. Look at the front panel LED. If a faulty battery is detected, the front panel LED will alternate between blinking for 1 second and staying ON for 1 second.
5. If more than one battery is installed, switch the unit ON in order to find out which battery is bad. Wait for at least 60 seconds after the unit is fully booted and then look for a message regarding battery A or B failure. Replace the bad battery or batteries.

Note:

The Single Battery Test is no longer supported and is not recommended for use.

Battery Fuel Gauge

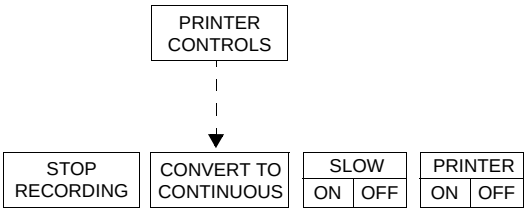
When the monitor is powered by batteries only, with 1 or 2 batteries installed, a battery fuel gauge is displayed in the lower right corner of the screen. This gauge is useful in detecting bad batteries or other voltage problems in the system. If, after 5 minutes of operation on only one fully charged battery, the battery fuel gauge reads 3/4 full or less, the battery is likely faulty or weak.

Battery Charger Troubleshooting

To verify that a faulty charger exists on the CPU PCBA:

1. Install a known good, fully discharged battery.
2. Power the monitor from the AC power supply and switch the monitor OFF. If the front panel LED does not blink, replace the CPU PCBA.
3. Let the battery complete a charge cycle: wait for 3 hours.
4. Look at the front panel LED. The front panel LED should be ON and not blinking. If not, replace the CPU PCBA. (Also, if the LED blinks for more than an hour, the charger is likely faulty).

Recorder Troubleshooting



The optional recorder module (P/N 050-0064-xx) downloads the printer control keys after it signs onto the SDLC bus. All of the printer control keys are initially inactive (appear dim on the screen). The PRINTER ON/OFF key becomes active (not dithered) only if the recorder module signs onto the SDLC bus with both an alive packet and on-line packet. If there is some failure in this process, the PRINTER ON/OFF key remains inactive. If this key is active and later becomes inactive, then some failure has deleted the recorder module from the SDLC bus.

At power ON, LED D2 on the recorder CPU PCBA (located under the recorder module) will be ON. As the recorder executes its diagnostics, the LED will turn ON and OFF with successive tests. If all diagnostics are passed, the recorder will sign-on to the SDLC link with the LED OFF. If a diagnostic error occurs, the LED is left ON or flashing.

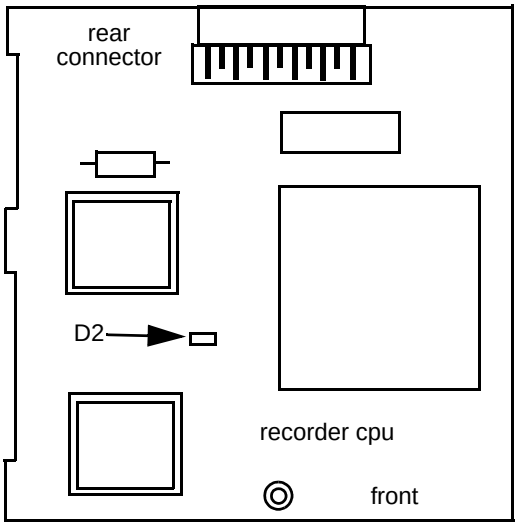


Figure 5-9: Location of D2 on recorder CPU

If a diagnostic error occurs, the recorder will attempt to print a diagnostic line instead of its usual sign-on message. This line is a series of hex numbers. Non-zero numbers represent error codes.

If the recorder is recognized by the monitor at power-ON, a PRINTER CONTROLS key is present.

Recorder Tips

If an OPEN DOOR key is not on the installed recorder:

1. Unplug the external power supply and rechargeable battery(ies).
2. Remove the recorder assembly by opening the paper door and loosening the two captive screws.
3. Remove the recorder CPU by loosening the thumb screw, fastening it to the chassis, pulling it outward, and lifting it out.
4. Re-install the recorder CPU by firmly inserting it into the connector. Occasionally when installing a Recorder CPU, a second effort proves that the connection was not fully seated. Tighten the thumb screw.
5. Re-install the recorder assembly and apply power. If the recorder door is closed and paper is properly loaded, the Recorder CPU initiates a self-test. If the test is successful, a line of 1/4” bars will print on the paper followed by the monitor’s model number, software version, and software date.
6. If the self-test fails, open the recorder door and remove the paper:
   - If the diagnostics detected a software failure on the recorder CPU, LED D2 will be steadily ON.
   - If the diagnostics detected a hardware failure in the recorder assembly, LED D2 will be continuously flashing ON and OFF.
   - If no failures were detected, LED D2 will be OFF.
7. If the recorder and the associated interface circuitry is good, an error report line is printed upon detection of an error.

During normal operation, D2 will be dimly lit (it is actually flashing very rapidly). LED Error Codes are shown in *Table 2*.

Table 2: Recorder Error Codes

Error Code (hex)	Failed Assembly or Likely Cause	Program Modules
80	EPROM checksum bad	Recorder Code Diagnostics (RCDIAG)
8F	Stack pointer bad	RCDIAG
81	Internal RAM won't write all zeroes	RCDIAG
82	Internal RAM won't write all ones	RCDIAG
83	Timer 0 - No overflow	RCDIAG
84	Timer 0 - High byte bad	RCDIAG
85	Timer 0 - Low byte bad	RCDIAG
86	Timer 1 - No overflow	RCDIAG
87	Timer 1 - High byte bad	RCDIAG
88	Timer 1 - Low byte bad	RCDIAG
30	SDLC Errors - Bad Xmit status	RCDIAG
31	SDLC Errors - No SI	RCDIAG
32	SDLC Errors - No start flag	RCDIAG
33	SDLC Errors - Bad address	RCDIAG
34	SDLC Errors - Bad frame type	RCDIAG
35	SDLC Errors - No end flag	RCDIAG
10	Stuck I/O bus bit 0 low	RCDIAG
11	Stuck I/O bus bit 1 low	RCDIAG
12	Stuck I/O bus bit 2 low	RCDIAG
13	Stuck I/O bus bit 3 low	RCDIAG

Table 2: Recorder Error Codes (continued)

Error Code (hex)	Failed Assembly or Likely Cause	Program Modules
14	Stuck I/O bus bit 4 low	RCDIAG
15	Stuck I/O bus bit 5 low	RCDIAG
16	Stuck I/O bus bit 6 low	RCDIAG
17	Stuck I/O bus bit 7 low	RCDIAG
18	Stuck I/O bus bit 0 high	RCDIAG
19	Stuck I/O bus bit 1 high	RCDIAG
1A	Stuck I/O bus bit 2 high	RCDIAG
1B	Stuck I/O bus bit 3 high	RCDIAG
1C	Stuck I/O bus bit 4 high	RCDIAG
1D	Stuck I/O bus bit 5 high	RCDIAG
1E	Stuck I/O bus bit 6 high	RCDIAG
1F	Stuck I/O bus bit 7 high	RCDIAG
50	External RAM - Stuck bit - Bank 0	RCDIAG
51	External RAM - Stuck bit - Bank 1	RCDIAG
52	External RAM - Stuck bit - Bank 2	RCDIAG
53	External RAM - Stuck bit - Bank 3	RCDIAG
58	3-Par RAM test error - Bank 0	RCDIAG
59	3-Par RAM test error - Bank 1	RCDIAG
5A	3-Par RAM test error - Bank 2	RCDIAG
5B	3-Par RAM test error - Bank 3	RCDIAG
22	Front Panel key input error	RCDIAG
23	EEPROM Tests - Checksum bad - No diagnostic jumper	RCDIAG
25	EEPROM Tests - Error during checksum write	RCDIAG

Table 2: Recorder Error Codes (continued)

Error Code (hex)	Failed Assembly or Likely Cause	Program Modules
26	EEPROM Tests - New checksum no good	RCDIAG
38	Printer Tests - WRRDY inactive or -SYNC active after reset	RCDIAG
39	Printer Tests - Readback system wrong state after reset	RCDIAG
3A	Printer Tests - Error active after reset	RCDIAG
3B	Printer Tests - +BUSY not active after idle CMD	RCDIAG
3C	Printer Tests - +BUSY not inactive after idle CMD	RCDIAG
3D	Printer Tests - Error not active after illegal CMD	RCDIAG
3E	Printer Tests - Error not inactive after idle CMD	RCDIAG
3F	Printer Tests - +BUSY not inactive after idle CMD	RCDIAG
40	Printer Tests - Incorrect feedback after illegal CMD	RCDIAG
41	Thermal array over-temperature	RCDIAG
42	Low 12 V supply to AR42 recorder	RCDIAG
43	High 12 V supply	RCDIAG
44	Other AR42 error	RCDIAG
27	Error detected during print test	RCDIAG
2A	SDLC cable not present	RCDIAG
2B	SDLC clock frequency too high	RCDIAG
2C	SDLC clock frequency too slow	RCDIAG
2E	Watchdog timeout too short	RCDIAG
2F	Watchdog timeout too long	RCDIAG
D1	Stack error	RCMAIN
67	Printer error code - Printer did not like command sent	RCKEYP

Table 2: Recorder Error Codes (continued)

Error Code (hex)	Failed Assembly or Likely Cause	Program Modules
60	Manual re-init seen	RCKEYP
69	Printer error during initialization	RCINIT
C0	Unload state error - Invalid state	RCUNLD
A1	Already printing when another print command received	RCREC1

Capnography Troubleshooting

The capnograph option requires the following supportive equipment:

- AC/DC power supply, P/N 119-0251-01

Problem Solving

Before you begin troubleshooting procedures, first establish that there is a fault with the parameter. Refer to your operators manual for specific information on parameter operation.

Diagnostic LEDs

The capnography software contains diagnostic tests for various sections of the microprocessor circuitry. If a problem is found, a code is displayed on LEDs D1, D2 and D3 that indicates where the problem is occurring. These LEDs are found on the CO_2/SDLC Capnography PCBA (P/N 670-0775-50).

Table 3: LED Diagnostic Codes

D1	D2	D3	Problem
1	1	1	Improper boot if the LEDs do not go out. Correct boot if LEDs momentarily go out.
0	1	1	UART error
1	0	1	RAM error
1	1	0	ROM error
1	1	1	CPU, utility register, or watchdog timeout error
1 = ON and 0 = OFF			

The following errors are indicated by a flashing code:

Table 4: Flashing LED Diagnostic Codes

D1	D2	D3	Problem
0	0	1	Timer 0 circuitry
0	1	0	Timer 1 circuitry (SDLC clock)
1	1	1	E2PROM error

If the Channel does not sign ON:

1. Check that side panel LED is steadily ON.
   - If yes, the processor is not running. Replace EPROM U37 and the CO_2/SDLC PCBA.
   - If no, open the rear cover and remove the I/O and wireless PCBA (if equipped) exposing the PCBA. Attach the loose end of the SDLC 9-pin connector to another monitor (90309/90303, etc.). Power ON the unit and proceed to step 2.
2. Check to see if any LEDs are on for the PCBA.
   - If they are, check to see if they are blinking approximately once per second (indicating a watchdog time-out). If there are no communications with the monitor, use another monitor. Replace EPLD U36 and the CO_2/SDLC PCBA.
   - If they are not, check power to the capnography unit. Check for +5V at J1 pin 2. Check for +12V at J1 pin 11. If voltage is present, replace the CO_2/SDLC PCBA.

O_2 Does Not Display

Note:

Model 90369-M does not include O_2 capability.

Nonfunctional O_2 Sensor

Plug one end of a known good O_2 cable into the O_2 sensor connector, measure the voltage between the tip and sleeve of the cable on the other end.

The sensor should produce 7 to 15 mV in room air. Replace the O_2 sensor if it is less than 7 mV.

Bad O_2 Cable

With a known good O_2 sensor connected to one end, you should measure 7 to 15 mV in room air. If a signal is measured at the sensor but not at the end of the cable, then replace the cable.

EMI Interface PCBA (for Option H only)

Attach a known good O_2 sensor and cable to the O_2 connector on the front panel of the module. Connect the DVM to pin 1 and pin 2 of J1 on the EMI interface PCBA. You should measure 7 to 15 mV in room air. If a signal is measured at the external cable but not between pins 1 and 2, then replace the EMI interface PCBA.

Oxygen Preamp/Analog to Digital Converter Problem

Attach a known good O_2 sensor and cable to the O_2 connector on the front panel of the module. If a signal is measured between TP10 and TP2 of the CO_2/SDLC PCBA, but no O_2 is displayed, then replace the CO_2/SDLC PCBA.

Flex Circuit Problem (for Option G only)

Attach a known good O_2 sensor and cable to the O_2 connector on the front panel of the module. Connect the DVM to TP10 and TP2 (isolated ground) on the CO_2/SDLD PCBA. The signal should measure 7 to 15 mV in room air. If a signal is measured at the external cable but not at TP10, replace the flex circuit.

O_2 Reads Low

O_2 Span Required

Perform a room O_2 span and a 100% O_2 span.

Weak O_2 Sensor

Plug one end of a known good O_2 cable into the O_2 sensor connector and measure the voltage between the tip and sleeve of the cable on the other end.

The sensor should produce 7 to 15 mV in room air. Replace the O_2 sensor if it is less than 7 mV.

Oxygen Preamp/Analog to Digital Converter Problem

Attach a known good O_2 sensor and cable to the O_2 connector on the front panel of the module. If 7 to 15 mV is measured between TP10 and TP2 of the CO_2/SDLC PCBA, but very low O_2 is displayed, replace the CO_2/SDLC PCBA. Replace the O_2 sensor if it is less than 7 mV.

Note:

If the O_2 reads correctly at room air but is low at 100% O_2, perform a 100% O_2 span. If this does not work, the sensor is weak and needs to be replaced. With normal use, the cell should last for about one year, but if it is used extensively at high concentrations of oxygen, it may become exhausted sooner.

CO_2 Check Reads Low

Refer to *Calibration* on page 4-8 for more information.

- Try an alternate gas bottle and repeat the check procedure.
- Verify that the barometric pressure value is correct. If it is not, replace the sensor interface PCBA.
- Replace the CO_2 sensor.
- Replace the Sensor Interface PCBA.

Problem Messages

If the following error messages are displayed for the Capnograph Option (G or H), perform the suggested corrective action:

Service Required

Check for power to the Sensor Interface PCBA.

1. Disconnect the module from the monitor.
2. Disconnect the Sensor Interface PCBA from the CO_2/SDLC PCBA.
3. Connect the module to the monitor using the SDLC extender cable.
4. Check for the following voltages on the appropriate connector of the CO_2/SDLC PCBA (use TP2 for ground reference).
5. If the voltage check does not pass, replace the CO_2/SDLC PCBA.

Pins on J3 for G	Voltage
1	+5 V ±0.25 V
6	+8 V ±0.5 V
13	-5 V ±0.25 V
14	-42 V (-38 to -50 V)
15	-8 V ±1.5 V

Pins on J2 for H	Voltage
7	+5 V ±0.25 V
8	+15 V ±1 V
9	-15 V ±1 V
10	+5 V ±0.5 V

Conduct a Loopback test:

1. Disconnect the module from the monitor.
2. Remove the original software from U37 of the CO_2/SDLC PCBA. Set aside for later use.
3. Install the test software (P/N 174-0527-01) into U37.
4. Jumper J2 pin 4 to J2 pin 5 of the CO_2/SDLC PCBA.
5. Connect the module using the SDLC extender cable and watch for the sign-on message. The message **LOOPBACK TEST PASSED** should appear (disregard the **O2 SPAN REQUIRED** or the **O2 ZERO REQUIRED** messages).

6 If the loopback test does not pass, replace the CO_2/SDLC PCBA.

7 If all the voltages are present and the loopback test passes, then the problem is likely in the Sensor Interface PCBA.

8 Replace the test software (P/N 174-0527-01) in U37 with the original software.

Sensor Fault

- Verify that the flex circuit is not damaged and that it is seated correctly in the connector. The flex circuit connector is unlocked by pulling the plastic housing away from the PCBA. The flex circuit should then pull out easily. To re-install, push the flex circuit into the connector until it bottoms out, approximately 0.29 inches (7 mm).
- Replace the CO_2 sensor.
- Replace the Sensor Interface PCBA.

Non-Spacelabs Medical Sensor Detected

- Replace the CO_2 sensor.

Sensor Temperature Failure

- Replace the CO_2 sensor.

Warm-up Time-out

- Replace the CO_2 sensor.

O2 Zero Rejected

- O_2 sensor and/or cable is plugged into O_2 jack. Unplug the connector.
- O_2 connector does not close when the plug is removed. Jumper TP10 to TP2 of the CO2/SDLC PCBA and repeat O_2 zero. If it passes, replace the flex circuit.
- If it fails the above test, there is something wrong with the O_2 amplifier or A to D converter. Replace the CO_2/SDLC PCBA.

O2 Span Rejected

- Refer to *O2 Reads Low* on page 5-27.

100% O2 Span Failed

- Refer to *O2 Reads Low* on page 5-27.

O2 Span Required

- Perform room and 100% O_2 spans (this is required whenever an O_2 sensor is changed or an O_2 ZERO calibration is performed).

Parts

Contents

Overview 1
Field Replaceable Parts List 1
Drawings 5

Overview

This chapter presents exploded views of top level assemblies for the 90367/90369 Ultraview 1030/1050 Portable Monitor. Circuit schematics are presented in the *Ultraview 1050 Monitor Technical Reference Manual* (P/N 070-0707-xx, located on CD-ROM 084-0700-xx).

Caution:

Printed circuit boards in this equipment contain static-sensitive devices. Handle them only at a static-safe workstation.

Field Replaceable Parts List

90367/90369 Description	Part Number
Interconnect PCBA service kit	050-0123-xx
Main PCBA	670-0851-xx
I/O PCBA (without option G or H)	650-0552-xx
I/O PCBA (with option G or H)	670-0850-01
Recorder with label service kit	050-0064-xx
Plug, recorder	134-0032-01
Frame assembly	650-0279-01
Bracket, ethernet, flexport, I/O bay	407-0324-xx
Latch, battery	105-0038-xx
Door, battery	202-0020-xx
Latch, battery door	105-0038-xx
Spring, battery door	214-0328-xx

90367/90369 Description	Part Number
Pin, hinge, battery door	214-0318-xx
Battery eject	214-0518-xx
Spring, extension 1.5 inches, 0.25 od	214-0334-01
Battery, sealed lead acid	146-0018-xx
Battery, nickel metal hydride	146-0055-xx
Plug, hole, SDLC port, 90309/90369	134-0044-xx
Touchscreen PCBA	670-0884-01
Fan	119-0186-01
Kit, Sharp backlight replacement	050-0156-xx
Kit, Sharp LCD replacement	050-0352-xx
Kit, NEC backlight replacement	050-0353-xx

External Power Supply Description	Part Number
AC/DC power supply, 18 V, 80 W	119-0251-01

90367/90369-G or -H (Capnography)

Option	Description	Part Number
G	Cable assy, sensor interface to CO_2/SDLC PCBAs	175-0869-xx
G	Flex cable	388-0582-xx
G	PCB assembly gas interface	670-0848-xx
G	CO_2/SDLC capnograph PCBA	670-0775-50
G	Sensor interface PCBA	670-8818-xx
H	CO_2/SDLC capnograph PCBA	670-9014-50
H	Sensor interface PCBA	670-8820-xx
H	EMI interface PCBA	670-0886-50
H	Flex EMI interface cable	175-1006-xx
G and H	Label, gas option, 90369	334-1957-xx
G and H	Label, ethernet, video, keyboard, alarm	334-1958-xx
G and H	Label, speaker, RS-232, mic, mouse	334-1974-xx
G and H	Retainer, ring, grooveless	343-0142-xx
G and H	Mounting strap for CO_2/SDLC PCBA	346-0014-xx
G and H	SDLC interface cable (internal)	176-0304-xx

Mounts Description	Part Number
Bed rail mount for 90367/90369	016-0369-xx
Bed rail mount for 90367/90369-G	016-0369-01
Power supply mount	016-0432-xx

90310 Description	Part Number
Clip, flat cable	344-0028-xx
Plate, shoe, 3 inch, module hsg, 90485	386-0191-01
Scr, 832 × .5, Pfh, 82, stlzn, 2 inch lb	212-0087-xx
Screw, decorative, 8-32, light gr	212-0086-xx
Card guide 5.5 inch	384067-010
Cable assy, PCBA to pwr supply	175-0939-xx
Connector PCBA, PCBA, 90310	670-0841-xx
Cable, antenna, 90310	175-0922-xx
Panel, drawer assy, 90310	016-0405-xx
Cable assy, ribbon, AUI, 90310	175-0938-xx
Antenna, pedestal mount, 90310	117-0030-xx
Wireless, mini-ISA, ETSI, radio PCBA	010-0914-05
Ethernet interface PCBA	670-0829-xx
Plug, hole, .343d, .25	134-0039-xx

Drawings

Title	Drawing Part Number	Drawing Number
Top Assembly	653-0056-00	1 (4 sheets)
I/O Bay, Capno -G with Ethernet Network Comm	653-0080-00	2 (4 sheets)
I/O Bay, SDLC, Alarm, Ethernet, Comm	653-0051-00	3 (2 sheets)
Bezel Assembly	653-0057-00	4 (1 sheet)
Rear Housing Assembly	653-0060-00	5 (1 sheet)
Chassis Assembly	653-0058-00	6 (1 sheet)
Recorder Option	653-0083-00	7 (1 sheet)
Wireless Ethernet	90367/90369	8 (1 sheet)
I/O Bay, Capno -H with Ethernet Network Comm	653-0080-50	9 (6 sheets)

Appendix A — Glossary

Contents

Terms 1

Terms

The following terms appear in this manual:

ASCII

American Standard Code for Information Interchange. A standardized way of assigning numerical codes to characters and control codes.

ATE

Automated test equipment used in performance testing of printed circuit assemblies.

Baud rate

Data transfer rate associated with serial data transfers, typically between personal computers via modems. Example: 9600 bits per second.

Bit map

Technique of drawing computer images by mapping the image in RAM.

BNC

A push and twist connector that allows a fast connect/disconnect of thin coaxial cable.

Boot ROM

Programmed ROM devices that contain basic data required to start a digital system at power up. This data generates instructions to the processor, allowing a limited set of start-up instructions.

CMOS RAM

Battery backed up device used to store configuration information such as node name, node ID, or bed names.

Composite video

Video display signal containing both video and sync information.

CPU

Central Processing Unit

CR/LF

Carriage Return / Line Feed

CTS

Clear To Send signal used in communication protocols.

DB-15

“D” shaped 15-pin connector of either male or female gender.

DB-26

“D” shaped 26-pin connector of either male or female gender.

DB-9

“D” shaped 9-pin connector of either male or female gender.

Degauss

Process of removing a magnetic charge from a material. Color screens are most susceptible to this type of charge creating “purity” problems.

Dot pitch

Method of comparison used to determine the quality of a display. It indicates the angle and proximity each dot has to the other.

DRAM

Dynamic Random Access Memory used for computer memory systems.

DTR

Data Terminal Ready signal used in communications protocol.

EEPROM

Electrically Erasable Programmable Read Only Memory. The portion of the monitor’s memory which holds sysgen information and hardware configurations.

EMI

Electrical Magnetic Interference generated by repetitive signals such as microprocessor clocks that can interfere with other devices or two-way radio communications.

EPP

Enhanced parallel port

ESD

Electrical Static Discharge. High voltage potentials carried on the body that are generated by walking across a carpeted floor or caused by low humidity environments, which can be discharged into an electronic device, damaging it.

Ethernet

The LAN technology that uses CSMA/CD physical access method and 10 Mbps digital transmission. The forerunner of the IEEE802.3 CSMA/CD standard.

Ferrite

RF (radio frequency) glossy material used in EMI suppression.

FPGA

Field-programmable gate array.

Flexport® System Interface

Spacelabs Medical device that communicates via RS-232 with other manufacturer’s equipment.

GDS

Global Data System

High level output

Analog signals supplied through a separate connector for use with external equipment.

I/O

Input Output port or device

IEEE

A U.S. professional organization active in the creation, promotion, and support of communications specifications and standards.

IP Address

Internet Protocol Addresses used in TCP/IP. Identifies packet origin/destination.

IRTS

Infrared Touchscreen. One of the user interfaces to the Spacelabs Medical monitoring system.

LAN

Local Area Network. A network system that provides a relatively small area with high speed data transmission at a low error rate.

Light transmittance

Measure of light levels as measured at the face of the CRT.

Lithium

Material used to construct a high energy battery for use in CMOS backed circuits.

MBIT

Measurement used for RAM devices. Example: 4Mbit device will contain 4 megabits of data.

Monitor name

Unique name sysgened into the monitor identifying it to all other monitors on the network.

Monitor ID

Unique identification sysgened into the monitor allowing an Ethernet address to be assigned.

NTSC

National Television Standard used for U.S. television video formats.

NVRAM

Non-Volatile RAM

OTPROM

One Time Programmable Read Only Memory device

PAL

International television video format

PCB or PCBA

Printed Circuit Board or PCB Assembly

PCI

Peripheral component interconnect

PCIS™

Patient Care Information System

PCMS™

Patient Care Management System

PFAIL

Power Failure notification line used to notify the CPU of an imminent AC power failure.

PIXEL

Smallest unit displayed on a CRT. One PIXEL equals a single dot on the display.

Plenum rated

Cable that must be used where toxic gases created by heat during a fire could not be tolerated. The plenum term refers to the return air path for an air conditioning system.

PM

Preventive Maintenance

PMC

PCI mezzanine card

Primary recorder

Network recorder that has first priority in receiving print requests.

Privileged access

Monitor operations not accessible to all users. A password is required to access these functions.

PS/2

IBM standard

PVC

Poly Vinyl Chloride used in production of non-plenum cables.

RAMDAC

Digital-to-Analog Converter with memory that converts digital video to analog video.

Recorder names

Names placed into the monitor to allow the user to send hard copy recordings to a specific network printer.

RGB

Red, green, blue

RISC

Reduced instruction set computing

ROM

Read only memory

RTC

Real time clock

RTGL

Real time graphics library

RTS

Ready-to-send signal used in communications protocols.

RXD

Receive Data. Used in communications protocols.

SDLC

Synchronous Data Link Control. Used for communication between the monitor and external devices such as modules, telemetry housings or Flexport system interfaces.

Secondary recorder

Network recorder where record requests made at a bedside or central are sent to if a primary recorder is busy.

SIMM

Single in-line memory module

SMA

Shared Memory ASIC

SRAM

Static RAM (CMOS RAM)

Stop bits

Quantity of bits used to discontinue transfer block in serial communications.

Subnet name

Unique subnetwork name identifying logically separated networks.

Sysgen

Spacelabs Medical's method to enable purchased options.

Tap block plug

Dummy plug used to seal up an unused hole tapped into a coaxial cable on an Ethernet system.

Tap block

Device used to "tap" into an active or inactive Ethernet coax cable.

TCP/IP

Transmission Control Protocol/Internet Protocol used as an underlying mechanism for moving packets of information between different machines on a local or wide-area network.

TLB

Translation lookaside buffer

Terminator

A resistive load attached to each end of a coaxial cable segment, or at a single end of an SDLC line. The function of a terminator is to match the characteristic impedance of the cable.

Transceiver (Ethernet)

Device located on coax cable or line powered attaching monitors to the network. These devices are bi-directional.

TXD (transmit data)

Transmit Data. Used in communications protocols.

UPS

Uninterruptable Power Supply. Used to hold power up until AC mains are restored.

VBA

Video Bus Array

VBB

Lithium Voltage Battery Back up

VPP

Voltage used for programming devices

VRAM

Video RAM

WDT

Watch Dog Timer

XON/XOFF

Used in communication definitions

Appendix B — Electromagnetic Compatibility

Contents

Electromagnetic Emissions 1
Electromagnetic Immunity 2
Frequency Separation Distances 3

Electromagnetic Emissions

Note:

This equipment has been tested under laboratory conditions and is suitable for use in all establishments, including domestic buildings and other buildings directly connected to the public low-voltage power supply network. The customer or user of this equipment should ensure that it is used in such an environment.

Emission Test	Compliance	Electromagnetic Environment
RF emissions **CISPR 11**	Group 1 Class B	The module uses RF energy only for internal function. Therefore, RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
Harmonic emissions **IEC 61000-3-2**	Complies	Mains power quality should be that of a typical commercial or hospital environment.
Voltage fluctuations/ flicker **IEC 61000-3-3**		

Electromagnetic Immunity

Note:

This equipment is intended for use in the electromagnetic environment specified in the table below. The customer or user of the equipment should ensure that it is used in such an environment.

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±8 kV contact ±15 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±1 kV for input/output lines and patient cables	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode		
Voltage dips, short interruptions, and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T for 0.5 cycle) 40% U_T (60% dip in U_T for 5 cycles) 70% U_T (30% dip in U_T for 25 cycles) <5% U_T (>95% dip in U_T for 5 seconds)		
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	60 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a commercial or hospital environment.

Note:

U_T is the AC mains voltage prior to application of the test level. All power line immunity tests were performed on the host monitor/module housing at 120 VAC/60 Hz and 230 VAC/50 Hz.

Frequency Separation Distances

Note:

This equipment is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or user of the equipment can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and this equipment, as recommended in the table below, according to the maximum output power of the communications equipment.

<table>
<tr><th colspan="4">Recommended Separation Distances Between Portable and Mobile RF Communications Equipment and the Monitor (always evaluate electronic equipment on site before use)</th></tr>
<tr><th>Immunity Test</th><th>IEC 60601 Test Level</th><th>Compliance Level</th><th>Electromagnetic Environment</th></tr>
<tr><td>Conducted RF
IEC 61000-4-6</td><td>150 kHz to 80 MHz
3 V r.m.s.</td><td>150 kHz to 80 MHz
3 V r.m.s.
1 kHz sine
80% AM

150 kHz to 80 MHz
3 V r.m.s.
2 Hz sine
80% AM</td><td rowspan="2">Portable and mobile RF communications equipment should be used no closer to any part of the monitor, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Recommended separation distance:
$d = \left[\frac{3.5}{V_1}\right]\sqrt{P}$
150 kHz to 80 MHz
$d = \left[\frac{3.5}{E_1}\right]\sqrt{P}$
80 MHz to 800 MHz
$d = \left[\frac{7}{E_1}\right]\sqrt{P}$
800 MHz to 2.5 GHz
Where P is the maximum output power rating of the transmitter in watts (W), according to the transmitter manufacturer, and d is the recommended separation distance in meters (m).
Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,* should be less than the compliance level in each frequency range.**
 Interference may occur in the vicinity of equipment marked with the following symbol.
IEC 60417-5140: Non-ionizing electromagnetic radiation</td></tr>
<tr><td>Radiated RF
IEC 61000-4-3</td><td>80 MHz to 2.5 GHz
3 V/m</td><td>80 MHz to 2.5 GHz
20 V/m
1 kHz sine
80% AM

80 MHz to 2.5 GHz
3 V/m
2 Hz sine
80% AM</td></tr>
</table>

Recommended Separation Distances Between Portable and Mobile RF Communications Equipment and the Monitor (always evaluate electronic equipment on site before use)

* *Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the monitors are used exceeds the applicable RF compliance level above, the monitors should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the monitors.*

** *Over the frequency range 150 kHz to 80 MHz, field strengths should be less than [V_1] V/m.*

Interference

RF fields pulsating at a sustained rate within the physiological pass band of this equipment may be detected and then displayed as a valid waveform, or the fields may alter a valid waveform and cause an erroneous parameter value.

Mitigation

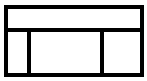
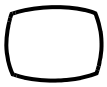
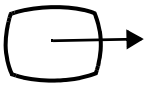
Evaluate on site. Troubleshoot with patient simulators and then determine the source of the interference. Separate the sensitive receivers from the causes of the interference (refer to the following table).

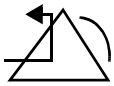
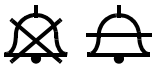
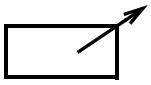
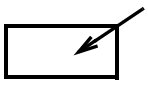
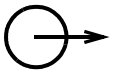
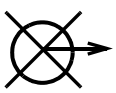
Rated Maximum Output Power of Transmitter (watts)	Separation Distance According to Frequency of Transmitter (meters)		
	150 kHz to 80 MHz	80 MHz to 800 MHz	800 MHz to 2.5 GHz
0.01	0.02	0.02	0.04
0.1	0.06	0.06	0.1
1	0.2	0.2	0.4
10	0.6	0.6	1.1
100	1.8	1.8	3.5

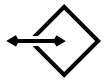
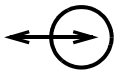
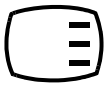
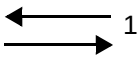
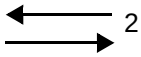
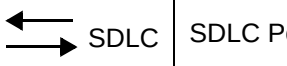
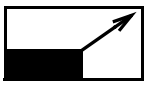
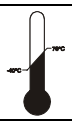
Note 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

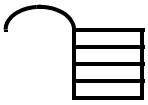
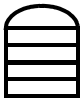
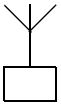
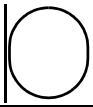
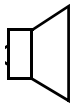
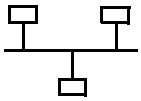
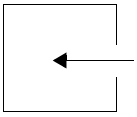
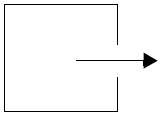
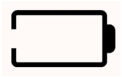
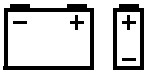
Appendix C — Symbols

The following list of international and safety symbols describes all symbols used on Spacelabs Medical products. No one product contains every symbol.

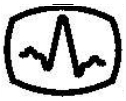
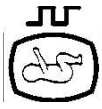
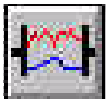
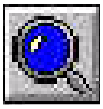
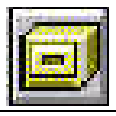
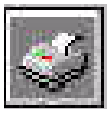
Symbol	Description	Symbol	Description
	HELP Key		Keyboard Connection
	SPECIAL FUNCTIONS Key		Mouse Connection
	RECORD Key		START/STOP Key
	NORMAL SCREEN Key		START/STOP
	MONITOR SETUP Key		STOP or CANCEL Key
	ALARMS Key		CONTINUE Key
	PREVIOUS MENU Key		ENTER Key
	ON — Power Connection to Mains		OFF — Power Disconnection from Mains
	ON Position for Push Button Power Switch		OFF Position for Push Button Power Switch
	On Direction		ON/OFF
	Television; Video Display		Video Output
	ON — Part of the Instrument Only		OFF — Part of the Instrument Only

Symbol	Description	Symbol	Description
	Standby		STANDBY Key
	PAUSE or INTERRUPT		Slow Run
	Reset		Power Indicator LED
	Alarm		Temporary Shut Off of Alarm Tone or Screen Indicators
	Indicator — Remote Control		Indicator — Local Control
	PRINT REPORT Key		Indicator — Out of Paper
	Partial ON/OFF		Recorder Paper
	Normal Screen		Return to Prior Menu
	Clock/Time Setting Key		TREND/TIMER Key
	HELP (Explain Prior Screen) Key		Keypad
	Activate Recorder for Graphics		Indoor Use Only
	START (NIBP) Key		Auto Mode (NIBP)
	Output		No Output (Terminated)

Symbol	Description	Symbol	Description
	Data Input/Output		Input/Output
	Input		Reset
	Menu Keys		Waveform/Parameter Keys
	Monitor Setup Select Program Options		Set Initial Conditions Menu
	Access Special Function Menu		Return Unit to Monitor Mode
	Serial Port 1		Serial Port 2
	External marker push button connection		SDLC Port
	Arterial Pulse		Electrocardiograph or Defibrillator Synchronization
	Gas Exhaust		Foot Switch
	Enlarge, Zoom		Delete
	PCMCIA Card		Event
	Keep Dry		Fragile; Handle with Care
	Environmental Shipping/Storage Altitude Limitations		This Way Up
	Environmental Shipping/Storage Temperature Limitations		Environmental Shipping/Storage Humidity Limitations

Symbol	Description	Symbol	Description
	Open Padlock		Closed Padlock
	Down Arrow		Up Arrow
	Hard Drive		Power Indicator LED
	Antenna		Mermaid Connector
	Microphone		Omnidirectional Microphone
	Audio Output, Speaker		Activate Telemetry Recorder
	Network Connection		Universal Serial Bus
	Gas Sampling Port		Gas Return Port
	Remote Alarm; Nurse Alert		Nurse Call
	Battery Status		Low Battery
	Battery Replace only with the appropriate battery.		Replace only with the appropriate battery. (+ / - signs may be reversed)
	All batteries should be disposed of properly to protect the environment. Lithium batteries should be fully discharged before disposal. Batteries such as lead-acid (Pb) and nickel-cadmium (Ni-Cd) must be recycled. Please follow your internal procedures and or local (provincial) laws regarding disposal or recycling.		This symbol indicates that the waste of electrical and electronic equipment *must not* be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

Symbol	Description	Symbol	Description
	Caution - hazardous voltages. To reduce risk of electric shock, do not remove the cover or back. Refer servicing to a qualified field service engineer (U.S.A.). DANGER - High Voltage (International)		Functional Earth Ground
	Protective Earth Ground		Fuse
	Replace Fuse Only as Marked		Equipotentiality Terminal
	Power supply jack polarity. (+ / - signs may be reversed)		Direct Current
	Alternating Current		AC/DC Input
	Both Direct and Alternating Current	Hz	Hertz
A	Amperes	W	Watts
V	Volts		IEC 60601-1 Class II equipment, double-isolated. The unit displaying this symbol does not require a grounded outlet.
	IEC 60601-1 Type B equipment. The unit displaying this symbol contains an adequate degree of protection against electric shock.		IEC 60601-1 Type BF equipment. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part providing an adequate degree of protection against electric shock.
	IEC 60601-1 Type BF equipment which is defibrillator-proof. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part which contains an adequate degree of protection against electric shock, and is defibrillator-proof.		IEC 60601-1 Type CF equipment. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part providing a high degree of protection against electric shock.

Symbol	Description	Symbol	Description
	IEC 60601-1 Type CF equipment. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part providing a high degree of protection against electric shock, and is defibrillator-proof.		Adult NIBP
	Loop Filter		Canadian Standards Association Approved
	ETL Laboratory Approved		Operates on Non-Harmonized Radio Frequencies in Europe
	Risk of Explosion if Used in the Presence of Flammable Anesthetics		Attention - Consult Operations or Service Manual for Description
Note	Note	**Caution**	Caution About Potential Danger to a Device
Warning	Warning About Potential Danger to Human Beings		Fetal Monitor Connection (Analog)
	Noninvasive Blood Pressure (NIBP), Neonate		Physiological Monitor Connection RS-232 (Digital)
	Fetal Monitor Connection RS-232 (Digital)		Sad Face
	Happy Face		Compression
	Magnifying Glass		List of Rooms
	File Cabinet		Printer
	Arrows		Service Message
	Recycle		Do Not Reuse; Single Use Only

Symbol	Description	Symbol	Description
LATEX	Latex-free		Reusable
	Radio transmitting device; elevated levels of non-ionizing radiation	REF	Catalog Number
LOT	Batch Code	NE 2	Nellcor Oxisensor II Compatible
	Date of Manufacture	NV X	Novametrix Compatible
c UL us	UL recognized component in Canada and United States	TruLink	Spacelabs TruLink Compatible
NELLCOR OXIMAX WORKS HERE	Nellcor OxiMax Compatible	OXIMAX	Nellcor OxiMax Compatible
MASIMO SET	Masimo SET Compatible		

Abbreviations used as symbols are shown below.

Symbol	Description	Symbol	Description
1 - 32	Access Codes 1 Through 32	**AIR**	Air
ANT 1 **ANT 2**	Diversity Antenna System 1 Diversity Antenna System 2	**Arr1** **ArrNet2**	Arrhythmia Net 1 Arrhythmia Net 2
CH **ch**	EEG, EMG, or ECG Channel EEG Channels - CH1, CH2, CH3, CH4 EMG Channel - CH5	**cmH_2O**	Centimeters of Water
C.O. **CO** **co**	Cardiac Output	**DIA** **dia**	Diastolic
ECG **ecg**	Electrocardiogram	**EEG** **eeg**	Electroencephalogram

Symbol	Description	Symbol	Description
EMG **emg**	Electromyogram	**ESIS**	Electrosurgical Interference Suppression
EXT	External	**FECG**	Fetal Electrocardiogram
FHR1 **FHR2**	Fetal Heart Rate, Channel 1 Fetal Heart Rate, Channel 2	**GND** **gnd**	Ground
HLO **hlo**	High-Level Output	**Multiview**	Multi-Lead Electrocardiogram
NIBP **nibp**	Noninvasive Blood Pressure	**N_2O**	Nitrous Oxide
O_2	Oxygen	**PRESS** **press** **PRS**	Pressure
RESP **resp**	Respiration	**SDLC**	Synchronous Data Link Control
SPO2 **SpO2** **SpO_2** **SaO_2**	Arterial Oxygen Saturation as Measured by Pulse Oximetry	**SVO2** **$S\underline{v}O2$** **SvO_2**	Mixed Venous Oxygen Saturation
SYS **sys**	Systolic	**T1** **T2** **T3** **T4**	Temperature 1 Temperature 2 Temperature 3 Temperature 4
TEMP **temp**	Temperature	**UA**	Uterine Activity or Umbilical Artery
VAC	Vacuum Connection	**UV**	Umbilical Venous